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FURUNO

OPERATOR'S MANUAL

MARINE RADAR

MODEL MODEL 1832/1932/1942

FURUNO ELECTRIC CO., LTD.
NISHINOMIYA, JAPAN

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•Your Local Agent/Dealer

 Printed in Japan

FIRST EDITION : JAN. 1997
P : OCT. 17, 2001

PUB. No. OME-34410
MODEL1832/1932/1942

(HIMA)

00080788700

OME34410P00

⚠ SAFETY INSTRUCTIONS

"**DANGER**", "**WARNING**" and "**CAUTION**" notices appear throughout this manual. It is the responsibility of the operator and the installer of the equipment to read, understand and follow these notices. If you have any questions regarding these safety instructions, please contact a FURUNO agent or dealer.

⚠ WARNING



Do not open the equipment.

Hazardous voltage which can cause electrical shock, burn or serious injury exists inside the equipment. Only qualified personnel should work inside the equipment.



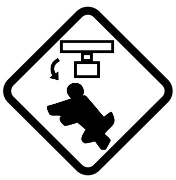
Wear a safety belt and hard hat when working on the antenna unit.

Serious injury or death can result if someone falls from the radar antenna mast.



Stay away from transmitting antenna.

The radar antenna emits microwave radiation which can be harmful to the human body, particularly the eyes. Never look directly into the antenna radiator from a distance of less than 1 m when the radar is in operation.



Turn off the radar power switch before servicing the antenna unit. Post a warning sign near the switch indicating it should not be turned on while the antenna unit is being serviced.

Prevent the potential risk of someone begin struck by the rotating antenna and exposure to RF radiation hazard.

⚠ WARNING

Do not disassemble or modify the equipment.

Fire electrical shock or serious injury can result.

Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock.

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.

⚠ CAUTION

Use the proper fuse.

Use of a wrong fuse can result in fire or permanent equipment damage.

Do not use the equipment for other than its intended purpose.

Personal injury can result if the equipment is used as a chair or stepping stool, for example.

Do not place objects on the top of the equipment.

The equipment can overheat or personal injury can result if the object falls.

FOREWORD

Congratulations on your choice of the FURUNO MODEL 1832/1932/1942 Marine Radar. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

For over 50 years FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics equipment. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your radar is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless properly installed and maintained. Please carefully read and follow the recommended procedures for installation, operation and maintenance.

While this unit can be installed by the purchaser, any purchaser who has doubts about his or her technical abilities may wish to have the unit installed by a FURUNO representative or other qualified technician. The importance of a through installation can not be overemphasized.

We would appreciate hearing from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

Features

Your radar has a large variety of functions, all contained in a remarkably small cabinet.

The main features of the MODEL 1832/1932/1942 are:

- Traditional FURUNO reliability and quality in a compact, lightweight and low-cost radar.
- Durable brushless antenna motor.
- On-screen alphanumeric readout of all operational information.
- Standard features include EBL (Electronic Bearing Line), VRM (Variable Range Marker), Guard Alarm, Display Off Center, and Echo Trail.
- Watchman feature periodically transmits the radar to check for radar targets which may be entering the alarm zone.
- Ship's position in latitude and longitude and Loran C Time Differences, range and bearing to a waypoint, and ship's speed/ heading/course can be shown in the bottom text area. (Requires a navigation aid which can output such data in IEC 1162 format.)
- Zoom feature provided.

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MODEL 1832 SPECIFICATIONS

ANTENNA UNIT

1. Radiator: Printed array
2. Radiator length: 60 cm
3. Horizontal beamwidth: 3.9°
4. Vertical beamwidth: 20°
5. Sidelobe:
   Within ± 20° of mainlobe; less than -18 dB
   Outside ± 20° of mainlobe; less than -23 dB
6. Polarization: Horizontal
7. Antenna rotation speed: 24 rpm
8. Wind resistance:
   Relative wind speed 100 knots (51.5 m/s)

TRANSCEIVER MODULE (contained in radome)

1. Transmitting tube: MG5248, E3571 or MAF1421B
2. Frequency:
   9410 MHz ±30 MHz
3. Peak output power: 4 kW nominal
4. Pulselength & pulse repetition rate:
   0.08 µs, 2100 Hz (0.125, 0.25, 0.5, 0.75, 1.5)
   0.3 µs, 1200 Hz (1.5, 2, 3)
   0.8 µs, 600Hz (3, 4, 6, 8, 12, 16, 24, 36)
5. Warmup time: 1:30
6. Modulator: FET switching method
7. I.F.: 60 MHz
8. Tuning: 3Automatic or manual
9. Receiver front end: MIC (Microwave IC)
10. Bandwidth:
    Tx pulselength 0.3 µs and 0.08 µs: 25 MHz
    Tx pulselength 0.8 µs: 3 MHz
11. Duplexer: Circulator with diode limiter

DISPLAY UNIT

1. Indication system: PPI raster scan
2. Display: 10-inch rectangular monochrome CRT
3. Range scale (nm):
   Range, Range interval and no. of Rings:
   0.125 (0.0625, 2), 0.25 (0.125, 4), 0.75 (0.25, 3), 1 (0.25, 4), 1.5 (0.5, 3), 2 (0.5, 4), 3 (1, 3), 4 (1, 4), 6 (2, 3), 8 (2, 4), 12 (3, 4), 16 (4, 4), 24 (6, 4), 36 (12, 3)
4. Bearing resolution: 4°
5. Bearing accuracy: Within 1°
6. Range discrimination: Better than 20 m
7. Range ring accuracy:
   0.9 % or range in use or 8 m, whichever is larger
8. Minimum range: Better than 25 m
9. Markers:
   Heading line, Bearing scale, Range ring, VRM 1/2, EBL 1/2, Tuning indicator, Cursor, Alarm zone, North mark (heading sensor input required)
10. Alphanumeric indication:
    Range, Range ring interval, Pulselength (SP, MP, LP), Display mode (HU, CU, NU, TM), Interference rejection (IR1, IR2, IR3), VRM (1,2), EBL (1, 2), Automatic A/C SEA (A/C AUTO), Stand-by (ST-BY), Radar alarm: G(IN)/G(OUT)/G(ACKN), Echo stretch (ES1, ES2), Range to cursor, Bearing to cursor, Echo trailing (TRAIL), Trail time, Trail elapsed time, Navigation data (navigation input required), heading (HDG, heading sensor input required)
11. Vibration:

Vibration	Total amplitude
5 to 12.5 Hz	± 1.6 mm
12 to 25 Hz	± 0.35 mm
25 to 50 Hz	± 0.10 mm

12. Temperature:
    Antenna unit; -25 °C to + 70 °C
    Display unit; -15 °C to + 55 °C
13. Humidity:
    Relative humidity 93% or less at + 40°C
14. Waterproofing: Antenna unit; IPX6
    Display unit; IPX5
15. Power supply & power consumption:
    12 V, 24 V or 32 VDC (10.2 V to 41.6 VDC) 50W
16. Protection feature:
    Protection against reverse polarity, overvoltage, overcurrent, and internal fault
17. Compass safe distance:

MODEL 1932 SPECIFICATIONS

ANTENNA UNIT

1. Radiator: Slotted waveguide array
2. Radiator length: 100 cm
3. Horizontal beamwidth: 3.9°
4. Vertical beamwidth: 27°
5. Sidelobe:
   Within ± 20° of mainlobe; less than -24 dB
   Outside ± 20° of mainlobe; less than -30 dB
6. Polarization: Horizontal
7. Antenna rotation speed: 24 rpm
8. Wind resistance:
   Relative wind speed 100 knots (51.5 m/s)

TRANSCEIVER MODULE (contained in antenna)

1. Pulselength & pulse repetition rate:
   0.08 µs, 2100 Hz (0.125, 0.25, 0.5, 0.75, 1.5)
   0.3 µs, 1200 Hz (1.5, 2, 3)
   0.8 µs, 600Hz (3, 4, 6, 8, 12, 16, 24, 36, 48)
2. Others: See MODEL 1832.

DISPLAY UNIT

1. Range scale (nm):
   Range, Range interval and no. of Rings:
   0.125 (0.0625, 2), 0.25 (0.125, 4), 0.75 (0.25, 3), 1 (0.25, 4), 1.5 (0.5, 3), 2 (0.5, 4), 3 (1, 3), 4 (1, 4), 6 (2, 3), 8 (2, 4), 12 (3, 4), 16 (4, 4), 24 (6, 4), 36 (12, 3), 48 (12, 4)
2. Compass safe distance:

	Standard compass	Steering compass
Display unit	0.75 m	0.6 m
Antenna unit	1.1 m	0.8 m

3. Others: See MODEL 1832.

MODEL 1942 SPECIFICATIONS

ANTENNA UNIT

1. Radiator: Slotted waveguide array
2. Radiator length: 120 cm
3. Horizontal beamwidth: 1.9°
4. Vertical beamwidth: 22°
5. Sidelobe:
   Within ± 20° of mainlobe; less than -24 dB
   Outside ± 20° of mainlobe; less than -30 dB
6. Polarization: Horizontal
7. Antenna rotation speed: 24 rpm
8. Wind resistance:
   Relative wind speed 100 knots (51.5 m/s)

TRANSCEIVER MODULE (contained in antenna)

1. Transmitting tube: MG5389 or E3560
2. Peak output power: 6 kW nominal
3. Pulselength & pulse repetition rate:
   0.08 µs, 2100 Hz (0.125, 0.25, 0.5, 0.75, 1.5)
   0.3 µs, 1200 Hz (1.5, 2, 3)
   0.8 µs, 600Hz (3, 4, 6, 8, 12, 16, 24, 36, 48, 64)
4. Bandwidth:
   Tx pulselength 0.3 µs and 0.08 µs: 25 MHz
   Tx pulselength 0.8 µs: 5 MHz
5. Others: See MODEL 1832.

DISPLAY UNIT

1. Range scale (nm):
   Range, Range interval and no. of Rings:
   0.125 (0.0625, 2), 0.25 (0.125, 4), 0.75 (0.25, 3), 1 (0.25, 4), 1.5 (0.5, 3), 2 (0.5, 4), 3 (1, 3), 4 (1, 4), 6 (2, 3), 8 (2, 4), 12 (3, 4), 16 (4, 4), 24 (6, 4), 36 (12, 3), 48 (12, 4), 64 (16, 4)
2. Compass safe distance:

	Standard compass	Steering compass
Display unit	0.75 m	0.6 m
Antenna unit	1.0 m	0.74 m

3. Power supply & power comsumption:
   12 V, 24 V or 32 VDC (10.2 V to 41.6 VDC)
   52W

INTERFACE IEC 1162 (NMEA0183)

(Input)

Own ship's position: GGA>RMA>RMC>GLL

Speed: RMA>RMC>VTG>VHW

Heading (True): HDT>HDG*>HDM*>VHW>VHW*

Heading (Magnetic): HDM>HDG*>HDT*>VHW>VHW*

Course (True): RMA>RMC>VTG

Course (Magnetic): VTG>RMA*>RMC*

Waypoint (Range, Bearing): RMB>BWC>BWR

Loran time difference: RMA>GLC>GTD

Water depth: DPT>DBT

Water temperature: MDA>MTW

XTE: RMB>XTE>APB

*: Calculated value based Magnetic variation.

(Output)

TLL: On using "TLL" Key.

RSD: An interval of four seconds.

TTM: ARP-10 (Option)

ARPA FUNCTION (OPTION)

1. Internal Board ARP-10
2. Acquisition
   Instant selection of auto or manual acquisition in 0.2 - 16 nm, relative speed 100kt.
3. Tracking
   Automatic tracking of up to 10 acquired targets betwen 0.1 to 16 nm.
4. Prediction of target motion
   True or relative vectors, time scaled.
5. Past position
   10 past positions of tracked targets.
6. Alarm Lost target. CPA/TCPA
7. Automatic tracking range 0.1 - 16 nm
8. Target information (one target selected)
   - Distance and bearing from own ship to target
   - Moving direction and speed
   - CPA (estimated Closest Point of Approach) and TCPA (estimated Time to CPA)
9. Vector length 30 sec. - 30 min.
10. Plotting interval 15 sec. - 6 min.

EQUIPMENT LIST

Complete Set

MODEL 1832

	Name	Type	Code No.	Qty	Remarks
1	Antenna Unit	RSB-0071-057		1	
2	Display Unit	RDP-118		1	
3	Installation Materials (select one)	CP03-16900	000-086-843	1 set	sig. cable assy. 10 m
		CP03-16910	000-086-844		sig. cable assy. 15 m
		CP03-16920	000-086-845		sig. cable assy. 20 m
		CP03-16930	000-086-846		sig. cable assy. 30 m
4	Accessaries	FP03-06400	000-086-872	1 set	
5	Spare Parts	SP03-12200	000-086-965	1 set	

MODEL 1932/1942

	Name	Type	Code No.	Qty	Remarks
1	Antenna Unit	RSB-0061-054A		1	For MODEL1932
		RSB-0062-055A		1	For MODEL1942
2	Display Unit	RDP-118		1	
3	Installation Materials (select one)	CP03-17000	000-086-848	1 set	sig. cable assy. 10 m
		CP03-17010	000-086-849		sig. cable assy. 15 m
		CP03-17020	000-086-850		sig. cable assy. 20 m
		CP03-17030	000-086-851		sig. cable assy. 30 m
4	Accessaries	FP03-06400	000-086-872	1 set	
5	Spare Parts	SP03-12200	000-086-965	1 set	

Optional Equipment

	Name	Type	Code No.	Qty	Remarks
1	ARP Board	ARP-10	000-086-852	1	
2	Rectifier	PR-62	000-013-484	1	1832, 100V AC
			000-013-485		1832, 110V AC
			000-013-486		1832, 220V AC
			000-013-487		1832, 230V AC
		RU-3423	000-030-443	1	1932/1942, AC
3	Magnifying Lens	03-121-1500	008-439-000	1	
4	Flush Mount Kit	OP03-145	008-476-060	1	
5	Mounting Bracket (1)	OP03-92	008-445-070	1	For MODEL1832
6	External Buzzer	OP03-21	000-030-097	1	*See note 1.
7	Cable Assy.	MJ-A6SPF0003-050	000-117-603	1	
		MJ-A6SPF0009-100	000-125-236		
		MJ-A6SPF0007-100	000-125-237		
		MJ-A6SPF00012-100	000-133-817		
		MJ-A6SPF00012-050	000-134-424		
		MJ-B24LPF0006-005	000-140-438		*See note 2.

Note 1) Even though the display unit meets waterproof standard IPX-5, the connection of external buzzer, radar plotter and/or remote display can affect waterproofness. Watertight integrity cannot be guaranteed. When these modification has been done, the display unit should not be mounted where exposed.

Note 2) Conversion from MCP connector (square type) to MJ connector (circular type).

Installation Materials

CP03-169xx (Model 1832)

	Name	Type	Code No.	Qty	Remarks
1	Signal Cable 10m	MJ-B24LPF0002-100	000-138-972	1	Select one. Connector fitted.
	Signal Cable 15m	MJ-B24LPF0002-150	000-138-970		
	Signal Cable 20m	MJ-B24LPF0002-200	000-138-974		
	Signal Cable 30m	MJ-B24LPF0002-300	000-138-973		
2	Power Cable	03S9332	000-138-928	1 set	
3	Slotted Head Hex Bolt	M10 x 25 SUS304	000-862-308	4	
4	Flat Washer	M10 SUS304	000-864-131	4	
5	Spring Washer	M10 SUS304	000-864-261	4	
6	EMC core	E04SS251512	000-144-673	1	

CP03-170xx (Model 1932/1942)

	Name	Type	Code No.	Qty	Remarks
1	Signal Cable 10m	MJ-B24LPF0002-100	000-138-972	1	Select one. Connector fitted.
	Signal Cable 15m	MJ-B24LPF0002-150	000-138-970		
	Signal Cable 20m	MJ-B24LPF0002-200	000-138-974		
	Signal Cable 30m	MJ-B24LPF0002-300	000-138-973		
2	Power Cable	03S9332	000-138-928	1	
3	Seal Washer	CW1053DX	000-850-021	4	
4	Hex Bolt	M12 x 60 SUS304	000-862-191	4	
5	Hex Nut	M12 SUS304	000-863-112	4	
6	Flat Washer	M12 SUS304	000-864-132	4	
7	Spring Washer	M12 SUS304	000-864-263	4	
8	Slotted Pin	10 x 45 SUS	000-866-390	2	

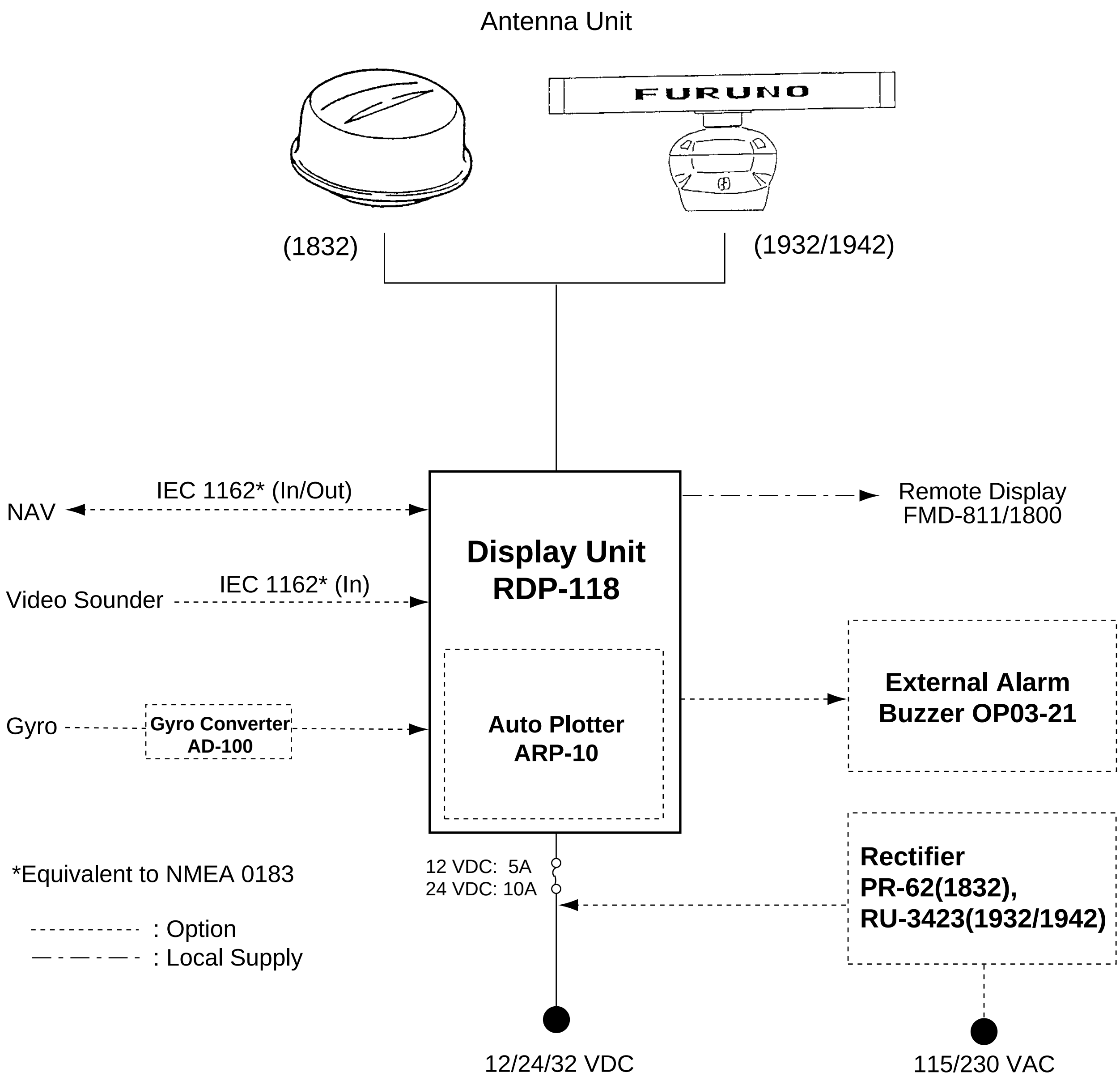
Spare Parts (SP03-12200)

	Name	Type	Code No.	Qty	Remarks
1	Fuse	FGBO-A5A AC125V	000-549-064	2	For 24/32 VDC power supply
2	Fuse	FGBO 10A AC125V	000-549-065	2	For 12 VDC power supply
3	Label (5A)	03-129-1512-0	100-248-780	1	For 24/32 VDC

Accessories (FP03-06400)

	Name	Type	Code No.	Qty	Remarks
1	Tapping Screw	6x20 SUS304	000-802-084	5	
2	Knob	FP03-06402	008-479-320	2	
3	Hanger	FP03-06401	008-479-310	1	
4	Hood Assy.	FP03-04810	008-441-400	1	

CONFIGURATION OF MODEL 1832/1932/1942



Note: Even though the display unit meets waterproof standard IPX-5, the connection of external buzzer, radar plotter and/or remote display can affect waterproofness. Watertight integrity cannot be guaranteed. When these modification has been done, the display unit should not be mounted where exposed.

1. PRINCIPLE OF OPERATION

1.1 What is Radar?

The term "RADAR" is an acronym meaning RAdio Detection And Ranging. Although the basic principles of radar were developed during World War II, echoes as an aid to navigation is not a new development.

1.2 How Ships Determined Position Before Radar

Before the invention of radar, when running in fog near a rugged shoreline, ships would sound a short blast on their whistles, fire a shot, or strike a bell. The time between the origination of the sound and the returning of the echo indicated how far the ship was from the cliffs or the shore. The direction from which the echo was heard indicated the relative bearing of the shore.

1.3 How Radar Determines Range

Radar determines the distance to the target by calculating the time difference between the transmission of a radar signal and the reception of the reflected echo. It is a known fact that radar waves travel at a nearly constant speed of 162,000 nautical miles per second. Therefore the time required for a transmitted signal to travel to the target and return as an echo to the source is a measure of the distance to the target. Note that the echo makes a complete round trip, but only half the time of travel is needed to determine the one-way distance to the target. This radar automatically takes this into account in making the range calculation.

1.4 How Radar Determines Bearing

The bearing to a target found by the radar is determined by the direction in which the radar scanner antenna is pointing when it emits an electronic pulse and then receives a returning echo. Each time the scanner rotates pulses are transmitted in the full 360 degree circle, each pulse at a slightly different bearing from the previous one. Therefore, if one knows the direction in which the signal is sent out, one knows the direction from which the echo must return.

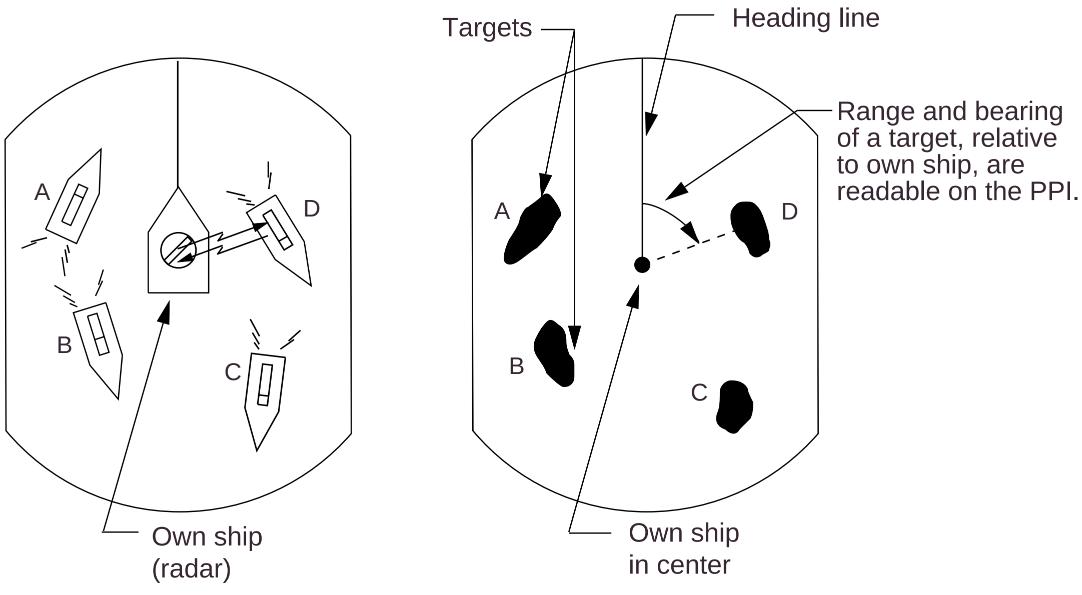
1.5 Radar Wave Speed and Antenna Rotation Speed

Note that the speed of the radar waves out to the target and back again as echoes is extremely fast compared to the speed of rotation of the antenna. By the time radar echoes have returned to the scanner, the amount of scanner rotation after initial transmission of the radar pulse is extremely small.

1.6 The Radar Display

The range and bearing of a target is displayed on what is called a Plan Position Indicator (PPI). This display is essentially a polar diagram, with the transmitting ship's position at the center. Images of target echoes are received and displayed at their relative bearings, and at their distance from the PPI center.

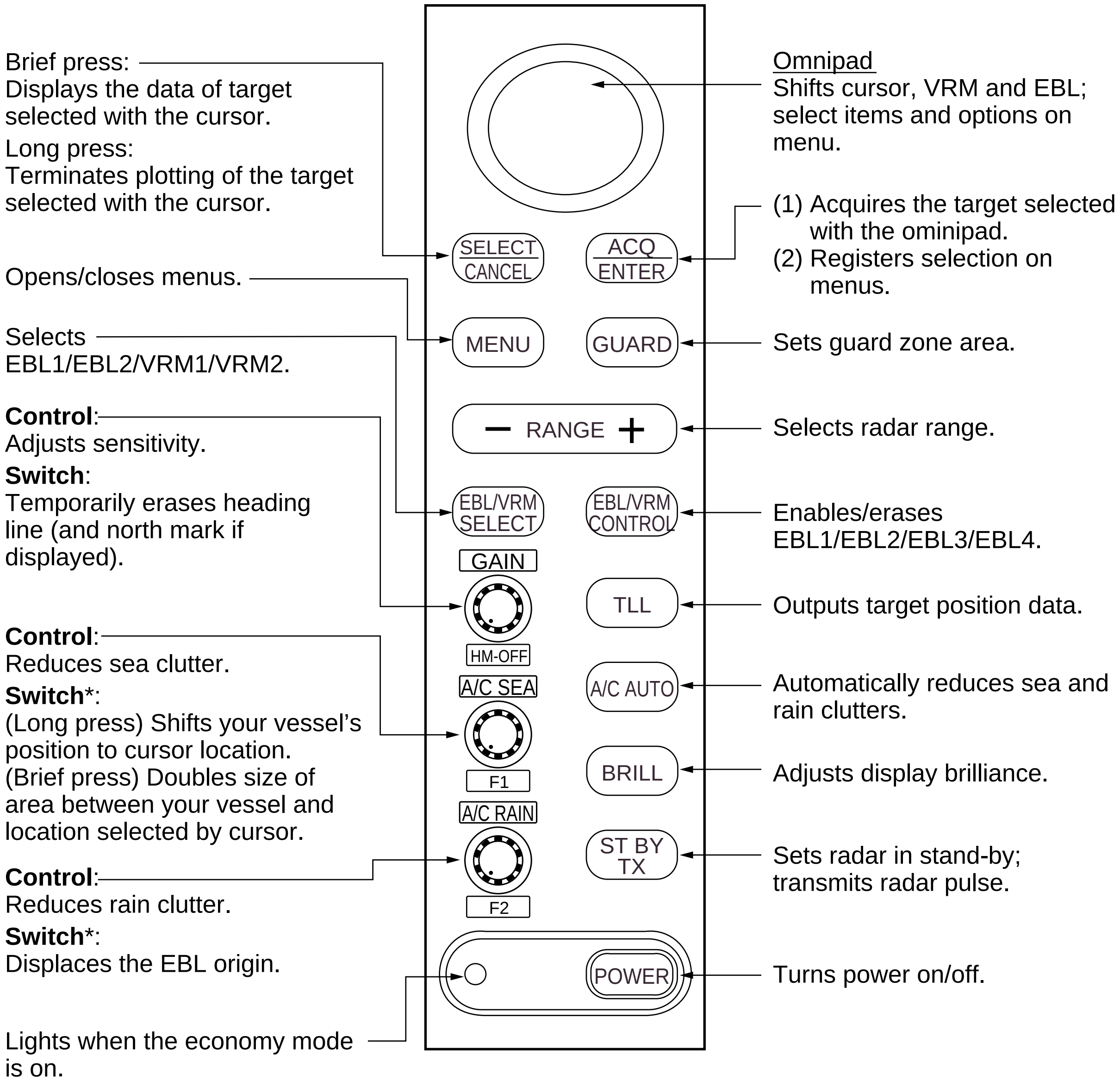
With a continuous display of the images of targets, the motion of the transmitting ship is also displayed.



(A) Bird's eye view of situation **(B) Radar picture of (A)**

Figure 1-1 How radar works

2.1 Control Description



*Default switch function.

Figure 2-1 Control panel

2.2 Display Indication and Markers

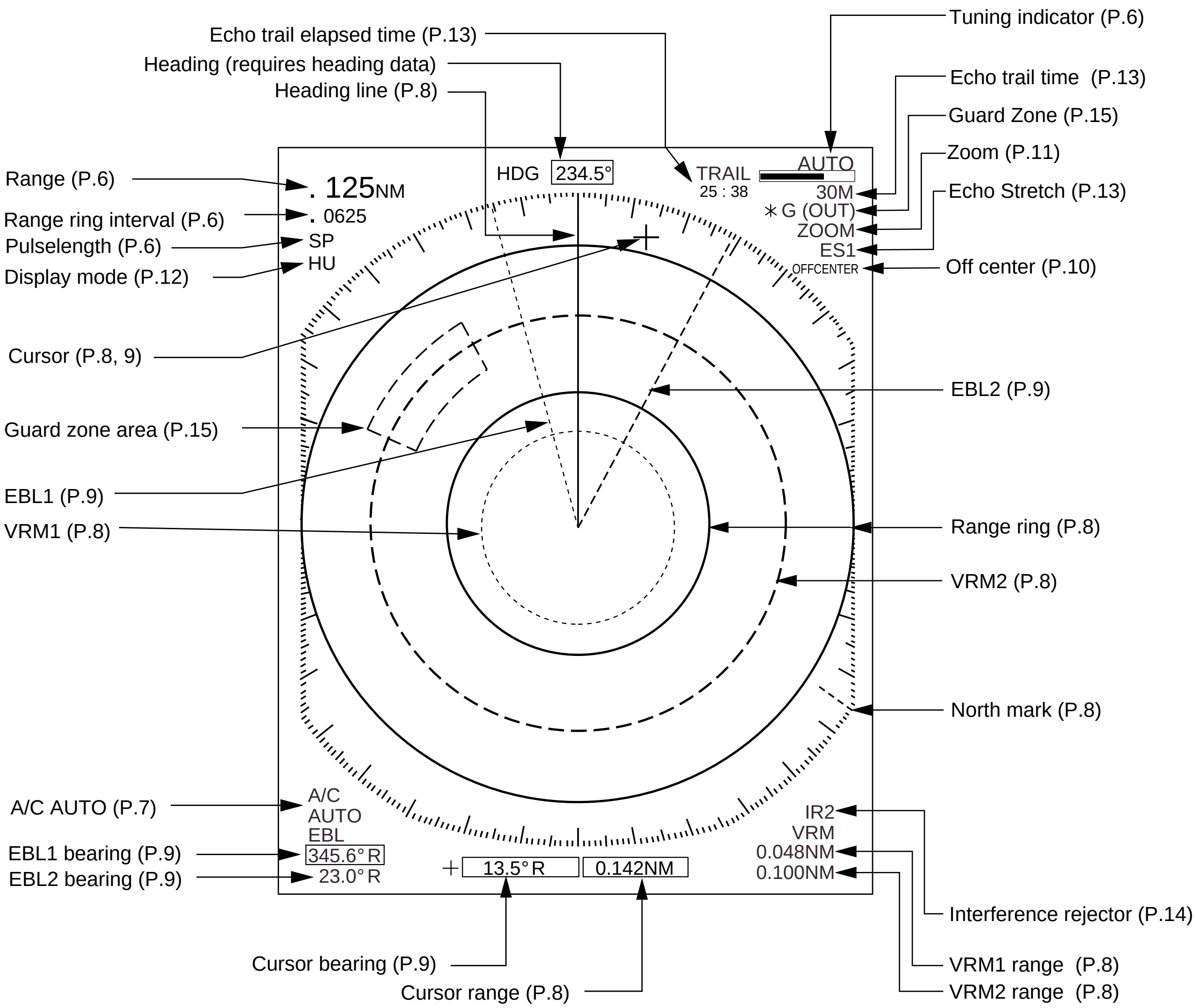


Figure 2-2 Display indications

2.3 Turning the Radar On/Off

Press the [POWER] key to turn the radar on or off.

The control panel lights and a timer displays the time remaining for warm up of the magnetron (the device which produces radar pulses), counting down from 1:30 to 0:01.

2.4 Transmitting

After the power is turned on and the magnetron has warmed up, STBY (Stand-By) appears at the screen center. This means the radar is now fully operational. In stand-by the radar is available for use at anytime - but no radar waves are being transmitted.

Press the [STBY TX] key to transmit.

When transmitting, any echoes from targets appear on the display. This radar displays echoes in eight tones of green according to echo strength.

2.5 Stand-by

When you won't be using the radar for an extended period, but you want to keep it in a state of readiness, place it in stand-by by pressing the [STBY TX] key. The display shows "STBY," navigation data, or goes into the economy mode depending on menu setting. (More on menu operation later.)

Economy mode

The CRT can be set to automatically turn itself off when in stand-by, to reduce power consumption. This feature is called the "economy mode." Power consumption in the economy mode is 28 W. When the economy mode is on, the lamp next to the [POWER] key lights.

Navigation data display during stand-by

If a navigation aid inputs navigation data to this radar, navigation data can be displayed during stand-by. You can turn the navigation data display on/off through the menu. Figure 2-3 shows a typical navigation data display during stand-by.

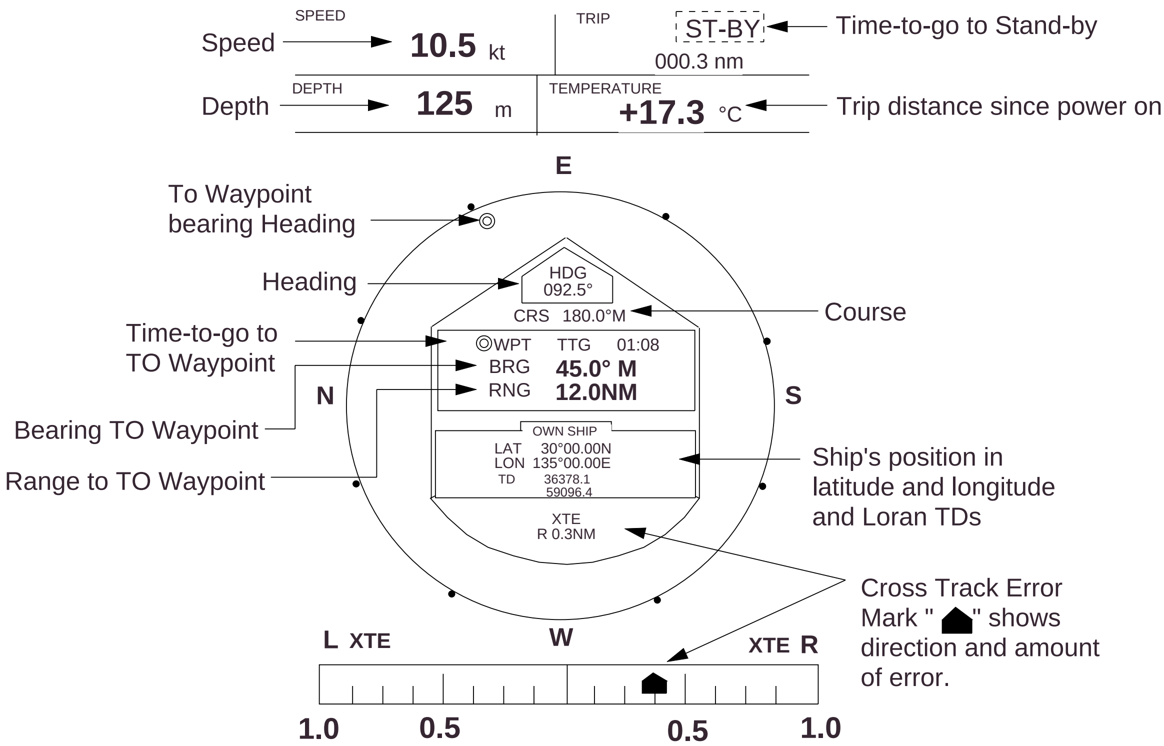


Figure 2-3 Typical navigation data display during stand-by

Note 1: Availability of a particular display item depends on incoming data.

Note 2: When Range to Waypoint reaches 0.1 nm, the WPT mark jumps to dead ahead even though a difference may exist between heading and BRG to WPT.

Note 3: When cross track error exceeds 1 nm on either side, the XTE mark starts blinking.

2.6 Selecting the Range

The range selected automatically determines the range ring interval, the number of range rings, pulselength and pulse repetition rate, for optimal detection capability in short to long ranges.

You can select which ranges and pulselength (for 1.5 and 3 mile ranges) to use through the menu. The range, range ring interval and pulselength appear at the top left-hand corner of the display.

To select a range;

Press the [- RANGE +] key. The range and range ring interval appear at the top left corner on the display.

Tips for selecting the range

- When navigating in or around crowded harbors, select a short range to watch for possible collision situations.
- If you select a lower range while on open water, increase the range occasionally to watch for vessels that may be heading your way.

2.7 Adjusting Picture Brilliance

The [BRILL] key adjusts the brilliance of the radar picture in sixteen levels.

Press the [BRILL] key to set the brilliance level. The current level momentarily appears on the screen.

2.8 Adjusting Receiver Sensitivity

The [GAIN] control adjusts the sensitivity of the receiver. It works in precisely the same manner as the volume control of a broadcast receiver, amplifying the signals received.

The proper setting is such that the background noise is just visible on the screen. If you set up for too little sensitivity, weak echoes may be missed. On the other hand excessive sensitivity yields too much background noise; strong targets may be missed because of the poor contrast between desired echoes and the background noise on the display.

To adjust receiver sensitivity, transmit on long range, and adjust the [GAIN] control so background noise is just visible on the screen.

2.9 Adjusting the A/C SEA Control (reducing sea clutter)

Echoes from waves can be troublesome, covering the central part of the display with random signals known as “sea clutter.” The higher the waves, and the higher the scanner above the water, the further the clutter will extend. Sea clutter appears on the display as many small echoes which might affect radar performance. (See the left-hand figure in Figure 2-4.) When sea clutter masks the picture, adjust the A/C SEA control to reduce the clutter.

How the A/C SEA control works

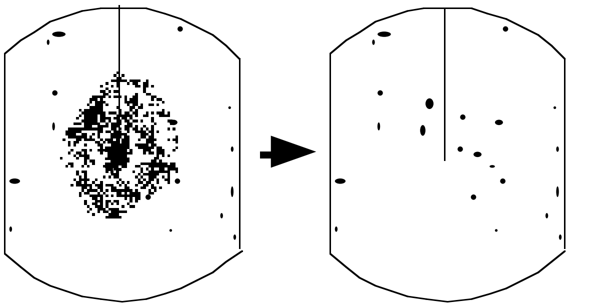
The [A/C SEA] control reduces the amplification of echoes at short ranges (where clutter is the greatest) and progressively increases amplification as the range increases, so amplification will be normal at those ranges where there is no sea clutter.

Adjusting the A/C SEA control

The proper setting of the A/C SEA should be such that the clutter is broken up into small dots, and small targets become distinguishable.

If the control is set too low, targets will be hidden in the clutter, while if it is set too high, both sea clutter and targets will disappear from the display. In most cases adjust the control until clutter has disappeared to leeward, but a little is still visible windward.

1. Confirm that the sensitivity is properly adjusted, and then transmit on short range.
2. Adjust the [A/C SEA] control so small targets are distinguishable but some clutter remains on the display.



Sea clutter at display center

A/C SEA control adjusted; sea clutter suppressed.

Figure 2-4 How to adjust the A/C SEA control

Tip for adjusting the A/C SEA

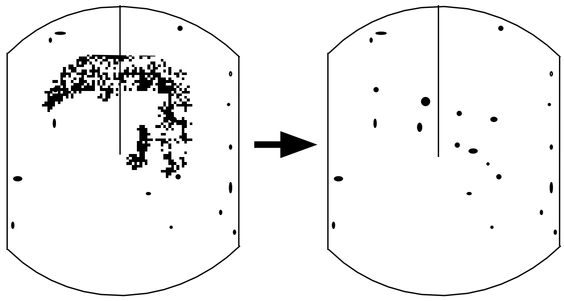
A common mistake is to over-adjust the circuit so all the clutter is removed. As an example set up for maximum A/C SEA. You will see how the center of the display becomes dark. This dark zone can be dangerous (targets may be missed), especially if the sensitivity is not properly adjusted. Always leave a little clutter visible on the display to be sure weak echoes will not be suppressed. If there is no clutter visible on the display, turn off the circuit.

2.10 Adjusting the A/C RAIN Control (reducing rain clutter)

The vertical beamwidth of the antenna is designed to see surface targets even when the ship is rolling. However, by this design the unit will also detect rain clutter (rain, snow, hail, etc.) in the same manner as normal targets. Figure 2-5 shows the appearance of rain clutter on the display.

Adjusting A/C RAIN

When rain clutter masks echoes, adjust the [A/C RAIN] control. This control splits up these unwanted echoes into a speckled pattern, making recognition of solid targets easier.



Appearance of rain clutter

A/C RAIN control adjusted; rain clutter suppressed.

Figure 2-5 Effect of A/C RAIN

Note: In addition to reducing clutter, the [A/C RAIN] control can be used in fine weather to clarify the picture when navigating in confined waters. However, with the circuit activated the receiver is less sensitive. Therefore, turn off the circuit when its function is not required.

Automatic adjustments of A/C SEA and A/C RAIN

Push the [A/C AUTO] key. “A/C AUTO” appears at the bottom left-hand corner of the display when the A/C AUTO circuit is on. You can fine tune by adjusting the [A/C SEA], [A/C RAIN] and [GAIN] controls.

2.11 Erasing the Heading Line, North Mark

The heading line or north mark (available with gyrocompass connection) may occasionally mask a target. To view the target, you can temporarily erase the heading line and north mark by pressing and holding down the [GAIN (HM OFF)] control. Release the control to re-display the marks.

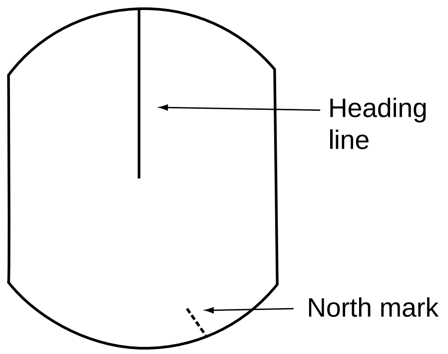


Figure 2-6 Heading line and north mark

2.12 Measuring the Range

You can measure the range to a target three ways: by the range rings, by the cursor, and by the VRM (Variable Range Marker).

By range ring

Count the number of rings between the center of the display and the target. Check the range ring interval and judge the distance of the echo from the inner edge of the nearest ring.

By cursor

Operate the omnipad to place the cursor intersection on the inside edge of the target echo, The range to the target, as well as the bearing, appears at the bottom of the display.

By VRM

1. Press the [EBL/VRM SELECT] key to circumscribe a VRM readout (at the bottom right-hand corner). Each press of the key selects the readout of EBL1, EBL2, VRM1 or VRM2 in that order.



Figure 2-7 Display bottom, showing location of EBL and VRM readouts

2. Press the [EBL/VRM CONTROL] key to enable control of the VRM by the omnipad.
3. Operate the omnipad to place the outside edge of the VRM on the inside edge of the target.
4. Check the VRM readout at the bottom right-hand corner of the display to find the range to the target.
5. To anchor the VRM, press the [EBL/VRM CONTROL] key.

To erase the VRM, press and hold down the [EBL/VRM CONTROL] key about two seconds.

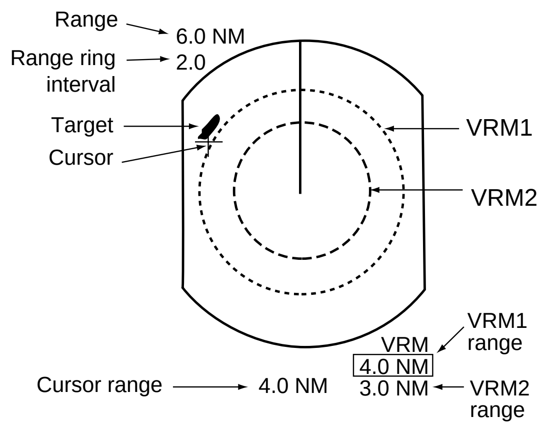


Figure 2-8 Measuring range by the cursor, range rings and VRM

Note: You can display the range readout of the VRM and cursor in nautical miles, statute miles or kilometers. For details see the next chapter.

2.13 Measuring the Bearing

There are two ways to measure the bearing to a target: by the cursor, and by the EBL (Electronic Bearing Line).

By cursor

Operate the omnipad to bisect the target with the cursor intersection. The bearing to the target appears at the bottom of the display.

By EBL

1. Press the [EBL/VRM SELECT] key to circumscribe an EBL readout (at the bottom left-hand corner). Each press of the key selects the readout of EBL1, EBL2, VRM1 or VRM2 in that order.
2. Press the [EBL/VRM CONTROL] key to enable control of the omnipad.
3. Operate the omnipad to bisect the target with the EBL.
4. Check the EBL readout at the bottom left-hand corner of the display to find the bearing to the target.
5. To anchor the EBL, press the [EBL/VRM CONTROL] key.

To erase the EBL and its readout, press and hold down the [EBL/VRM CONTROL] key about two seconds.

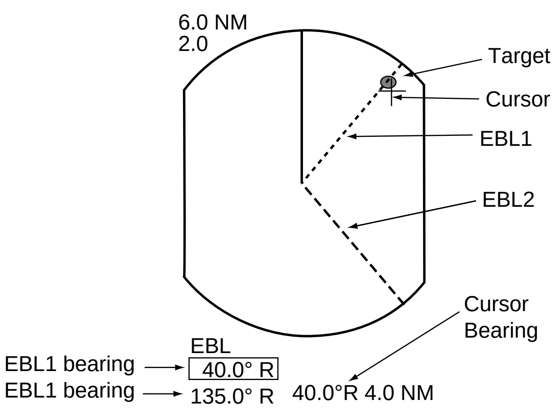


Figure 2-9 How to measure bearing by EBL and cursor

Note: The bearing readout for the EBL and the cursor can be displayed in relative or true bearing (true bearing requires heading sensor input). For north up and course up display modes the bearing reference is always true. For details see the next chapter.

Tips for measuring bearing

- Bearing measurements of smaller targets are more accurate; the center of larger target pips is not as easily identified.
- Bearings of stationary or slower moving targets are more accurate than bearings of faster moving targets.
- To minimize bearing errors keep echoes in the outer half of the picture by changing the range scale; angular difference becomes difficult to resolve as a target approaches the center of the display.

2.14 Using the Offset EBL

The offset EBL provides two functions: predict collision course of radar target and measure the range and the bearing between two targets.

Predicting collision course

1. Press the omnipad to place the cursor on the center of the target.
2. Press the [EBL/VRM SELECT] key to choose EBL1 readout and then press the [EBL/VRM CONTROL] key.
3. Select EBL OFFSET on the menu and press the [ACQ/ENTER] key.
4. Press the [EBL/VRM CONTROL] key.
5. Operate EBL1 so it passes through the center of the target.

If the target tracks along the EBL towards the center of the display (your vessel's position), the target may be on a collision course.

To cancel, select EBL OFFSET and press the [ACQ/ENTER] key.

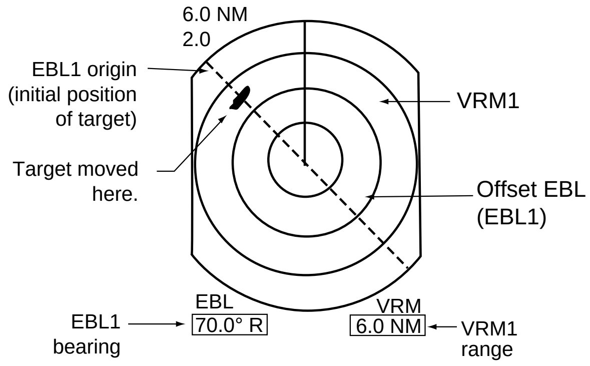


Figure 2-10 Predicting collision course by using the offset EBL

Measuring range and bearing between two targets

The procedure which follows shows how to measure the range and bearing between target “A” and target “B” in Figure 2-11.

1. Press the omnipad to place EBL1’s origin (cursor) on the center of target “A”.
2. Press the [EBL/VRM SELECT] key to choose EBL1 readout and then press the [EBL/VRM CONTROL] key.
3. Select EBL OFFSET on the menu and press the [ACQ/ENTER] key. EBL1’s origin shifts to cursor.
4. Press the [EBL/VRM CONTROL] key.
5. Press the omnipad to bisect target “B” with EBL1. Check the EBL1 readout to find the bearing between target “A” and target “B”.
6. Press the [EBL/VRM SELECT] key to choose VRM1 readout. Press the omnipad to place the outside edge of VRM1 on the inside edge of target “B.” Check the VRM1 readout to find the range between target “A” and target “B”.
7. To cancel, select EBL OFFSET on the menu and press the [ACQ/ENTER] key.

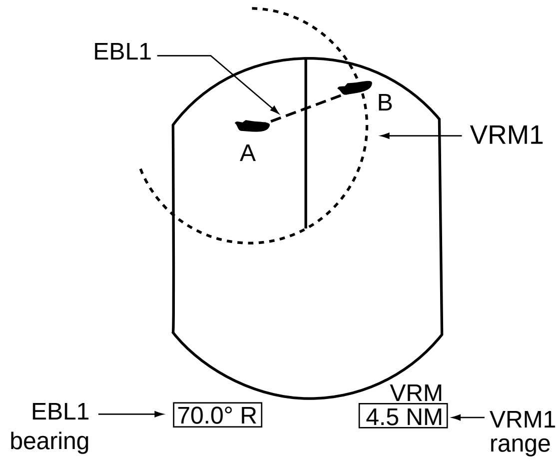


Figure 2-11 Measuring the range and bearing between two targets by using the offset EBL

2.15 Shifting (off centering) the Picture

Your vessel’s position can be shifted up to 75% of the range in use to view the situation around your vessel without changing the range or size of targets.

1. Press the omnipad to set cursor where desired.
2. Press the [F1 (A/C SEA)] control if its function is set for SHIFT (default setting), or select SHIFT on the menu. OFFCENTER appears at the top right corner of the display when the picture is shifted.

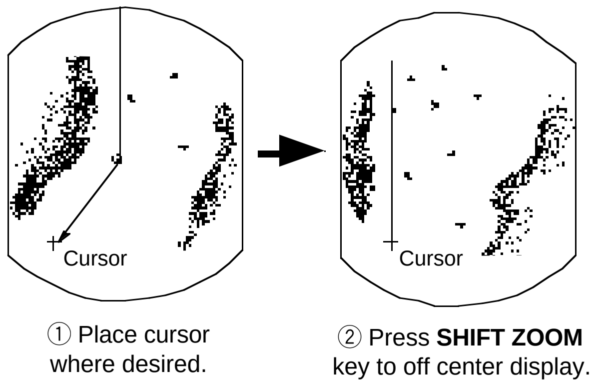


Figure 2-12 Shifting the picture

Cancelling shifted picture

Press the [F1 (A/C SEA)] control again.

2.16 Zoom

The zoom feature allows you to double the size of the area between your vessel and any location within the current range to take a closer look at an area of interest.

1. Select location with the cursor.
2. Press and hold down the [F1 (A/C SEA)] control about two seconds if its function is set for ZOOM (default setting), or select ZOOM on the menu. Zoom appears at the top right corner when the ZOOM function is on.

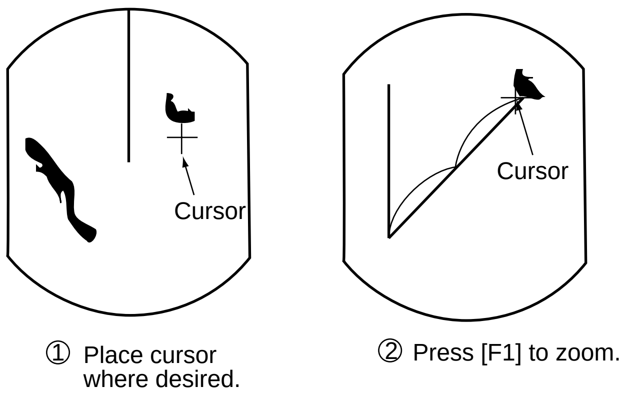


Figure 2-13 Zoom function

Note 1: Zoom is cancelled when range or presentation mode is changed.

Cancelling zoom

Press the [F1 (A/C SEA)] control again.

3. MENU OPERATION

3.1 Basic Menu Operation

The menu mostly contains less-often used functions which once preset do not require regular adjustment. To open or close the menu, press the [MENU] key. You can select items on the menu with the omnipad. The complete menu appears on page AP-1.

1. Press the [MENU] key to display the main menu.

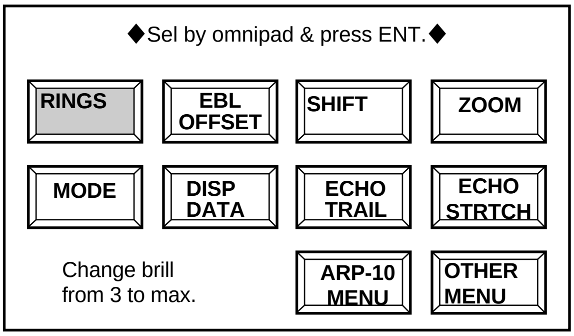


Figure 3-1 Main menu

2. Press the omnipad to select the item. For example, select RINGS. A message appears at the bottom of the menu window.
3. Press the [ACQ/ENTER] key to select setting. Each time this key is pressed, the message changes. For the RINGS menu, the message sequence is as shown below.

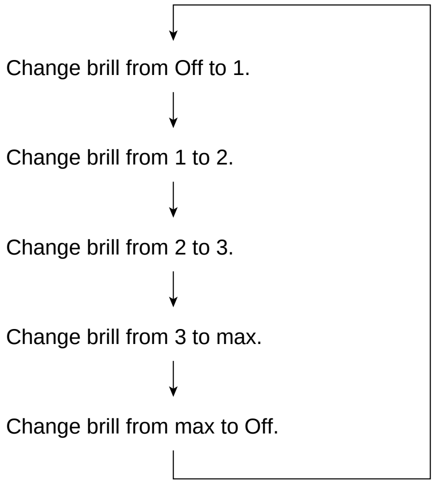


Figure 3-2 Messages for RINGS menu

4. Press the [MENU] key to close the menu.

3.2 Selecting the Presentation Mode

This radar provides four presentation modes: head-up, course-up, north-up and true motion.

1. Press the [MENU] key.
2. Operate the omnipad to select "MODE".
3. Press the [ACQ/ENTER] key.

With heading sensor connection the display and the display mode indication at the top left-hand corner of the display change in the sequence of HU (heading up), CU (course up), NU (north up) and TM (true motion) when the [ACQ/ENTER] key is pressed. If there is no heading sensor connection, the display mode is always HU.

4. Press the [MENU] key to close the menu.

Note: The radar begins operation with last selected display mode (except course up) whenever the unit is turned on. Note however that head up is selected when course up was the last used mode.

Head up

The picture is oriented so the heading line is at the top of the display. This mode is useful for navigation in congested waters.

Course up

The course up mode shows ship's heading by the heading line, at the top of the display. To get heading desired, steer vessel in direction desired, and then show "CU" at the top left-hand corner of the display.

North up

North is at the top of the display and the heading line moves with ship's heading. This mode is useful for determining ship's position and as a navigation monitor on a nautical chart. The picture is stabilized against yaw of vessel, thereby reducing of target echoes.

True motion

True motion displays own ship and moving objects in their true motion.

3.3 Magnifying Long Range Echoes (echo stretch)

Normally, the reflected echoes from long range targets appear on the display as weaker and smaller blips even though they are compensated by the radar's internal circuitry. The echo stretch function magnifies these small blips in all ranges. Two types of echo stretch are available: ES1 which stretches echoes in bearing direction and ES2 which stretches them in both range and bearing directions.

To turn the echo stretch on or off;

1. Press the [MENU] key to open the menu.
2. Select "ES".
3. Each press the [ACQ/ENTER] key changes the echo stretch function in the sequence of ES1, ES2 and OFF. ES1 or ES2 appears at the top right-hand corner of the display when echo stretch is on.

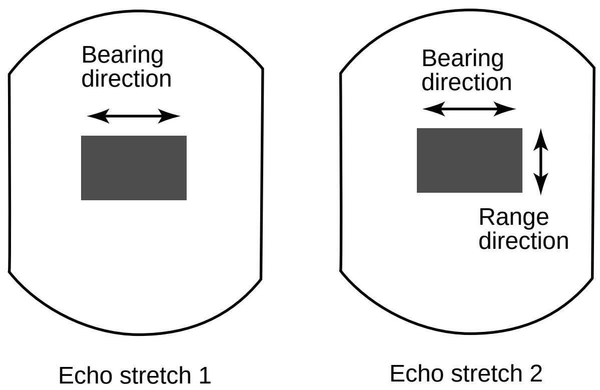


Figure 3-3 Echo stretch

Note: This function magnifies not only targets but also sea clutter and radar interference. For this reason be sure the controls for adjustment of sea clutter and radar interference are properly adjusted before activating the echo stretch.

Note: ES2 is not available on Short Range.

3.4 Echo Trail

You can show the movement of all radar targets relative to your vessel in afterglow. This function is useful for alerting you to possible collision situations.

Starting echo trail

1. Press the [MENU] key to open the menu.
2. Select "ECHO TRAIL" by the omnipad.
3. Select "ACTIVATE" by pressing the [ACQ/ENTER] key.

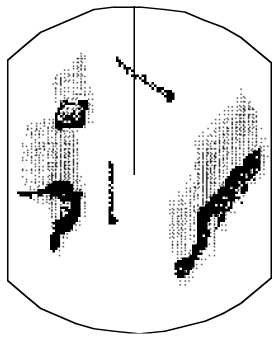


Figure 3-4 How the echo trail feature works

TRAIL, the echo trail time selected (on "OTHER MENU") and elapsed time appear at the top right-hand corner of the display. Then, afterglow starts extending from all targets.

Note: Trails are restarted when range or mode is changed or zoom or shift is turned on.

Fixed time trail

1. When the elapsed time clock counts up to the trail time selected, the elapsed time display freezes.
2. The oldest portions of trails are erased so only the latest trail, equal in length to the trail time selected, is shown.
3. Trail continues.

For example, the one minute trail time is selected. When the elapsed time clock counts up to 60 seconds, the elapsed time display freezes at "60," but the latest one minute of trail are erased and then trail continuous.

Continuous trail

The maximum continuous trail time is 99 minutes and 59 seconds. When the elapsed time clock counts up to that time the elapsed time display is reset to zero and trail begins again.

Cancelling echo trail

Select "OFF (deactivate)" at "ECHO TRAIL" on the menu.

Changing trail attributes

Trail gradation and trail time can be selected on the OTHERS menu.

Table 3-1 Trailing attributes

Item in OTHERS menu	Description
Trail Tone	Trails can be shown in single or multiple gradations. Multiple paints trails getting thinner with time just like the afterglow on an analog PPI radar. **Single** **Multiple** 
Trail Time	Trail time can be set for 15 sec., 30 sec., 1 min., 3 min., 6 min., 15 min., 30 min., or continuous.

3.5 Suppressing Radar Interference

Radar interference may occur when near another shipborne radar operating in the same frequency band as your radar. Its on-screen appearance is many bright dots either scattered at random or in the form of dotted lines extending from the center to the edge of the display. Figure 3-5 illustrates interference in the from of curved spokes. Interference effects are distinguishable form normal echoes because they do not appear in the same place on successive rotations of the antenna.

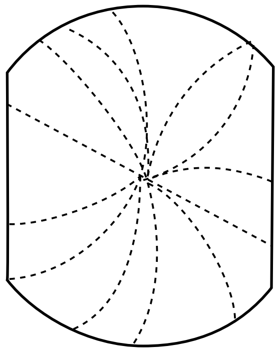


Figure 3-5 Radar interference

Four levels of interference are available, including off; IR1, IR2, IR3 and OFF. IR3 provides the highest level of rejection.

1. Press the [MENU] key.
2. Select "OTHER MENU" and press the [ACQ/ENTER] key.

[OTHERS]
Select item by omnipad
and press ENTER key.

1. Panel Dimmer	1	2	3	4		
2. Mark Brill	1	2	3	4		
3. HD Mark	1	2	3	4		
4. Characters	1	2	3	4		
5. Trail Tone	Single	Multi				
6. Int Reject	Off	1	2	3		
7. Pulselength	Short	Long				
8. Noise Reject	Off	On				
9. Trail Time	15S	30S	1M			
	3M 6M	15M	30M	Cont		
10. Tune	Auto	Manu				
11. Disp Data	Off	Nav	ARP	All		
12. WPT Mark	Off	On				
13. EBL Ref	Rel	True				
14. VRM Unit	nm	km	sm			
15. Watchman	Off	5M	10M	20M		
16. STBY Disp	Norm	Econo	Nav			
17. Guard Mode	In	Out				
18. Own Position	L/L	TD				
19. Cursor Posi	R/B	L/L				
20. Alm sense LV	Low	Mid	Hig			
21. Dead Sector	Off	On				
22. Range	1/8	1/4	1/2	3/4	1	1.5
	2	3	4	6	8	12 16 24 36
23. Self Test						
24. Installation Setup						

Figure 3-6 OTHER MENU

3. Select “6. IntReject”.
4. Select level desired by operating the omnipad.
5. Press the [ACQ/ENTER] key.
6. Press the [MENU] key to close the menu.

IR and level selected appears at the bottom right corner on the display when the interference rejection circuit is turned on.

3.6 Selecting Pulsewidth

Pulsewidth is the transmission time of a single radar pulse. The longer the pulsewidth the greater the direction range capability, however range accuracy and range resolution are reduced.

Pulsewidth can be selected to short or long on the 1.5 and 3 nautical mile ranges.

1. Press the [MENU] key.
2. Select “OTHER MENU” and press the [ACQ/ENTER] key.
3. Select “7. Pulselength”.
4. Select Short or Long by pressing the omnipad.
5. Press the [ACQ/ENTER] key to select.
6. Press the [MENU] key to close the menu.

3.7 Guard Alarm

The guard alarm allows the operator to set the desired range and bearing for a guard zone. When ships, islands, landmasses, etc. violate the guard zone an audible alarm sounds and the offending target brinks to call the operator’s attention.

Selection of guard zone type

The guard alarm can be set to sound when a target either enters or exits the guard zone. You can select which type of guard alarm you want through the menu.

In alarm

The alarm sounds on targets entering the guard zone. “G (IN)” appears at the top right-hand corner when the In alarm is selected.

Out alarm

The alarm sounds on targets exiting the guard zone. “G (OUT)” appears at the top right-hand corner when the Out alarm is selected.

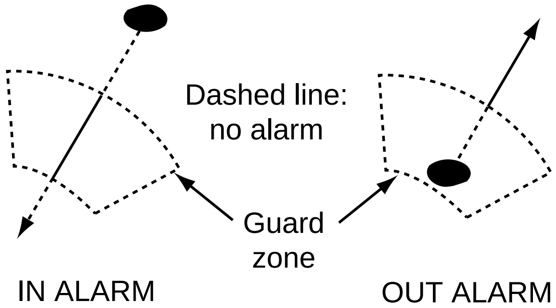


Figure 3-7 In and Out alarm

Setting a guard zone

Preparation

1. Press the [MENU] key, and then select “OTHER MENU” and pressing the [ACQ/ENTER] key.
2. Select “17. Guard Mode” and “In” (alarm on target entering zone) or “Out” (alarm on target exiting zone) by operating the omnipad.
3. Press the [ACQ/ENTER] key.
4. Press the [MENU] key to close the menu.

To set a guard zone

1. Mentally create the guard zone you want to set.
2. Operate the omnipad to set the cursor on point A or B. Press the [GUARD] key. “*G (IN)” or “*G (OUT)”, with asterisk blinking, appears at the top right-hand corner of the display. See Figure 3-8 (2). (The asterisk indicates the guard zone is partially set.)
3. Operate the omnipad to set the cursor on point C or D. See Figure 3-8 (3).
4. Press the [GUARD] key. The asterisk disappears. See Figure 3-8 (4).

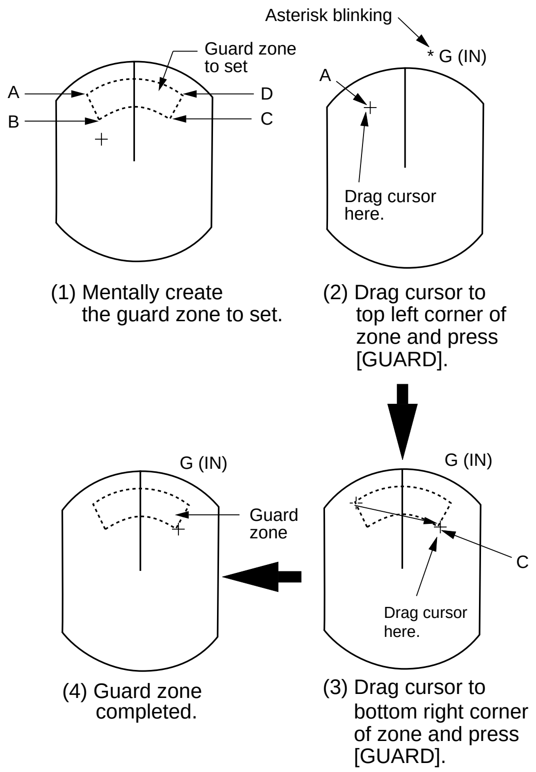


Figure 3-8 How to set the guard zone

Silencing the audible alarm

Any radar targets violating the guard zone will trigger the audible alarm. You can silence the audible alarm by pressing the [GUARD] key. When this is done, "G(ACKN)" replaces "G(IN)." This means the alarm is acknowledgrd. Press the key again to reactivate the alarm.

Cancelling the guard zone and guard alarm

Press and hold down the [GUARD] key until the guard zone disappears.

Notes on the guard alarm

- The alarm is a useful anti-collision aid, but does not relieve the operator of the responsibility to also keep a visual lookout for possible collision situations.
- When the radar range is less than one half of the guard zone range, the guard zone disappears and "G (IN)" or "G (OUT)" appears in inverse video. If this happens, raise to re-display the guard zone.
- A target echo does not always mean a landmass, reef, ships or surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the operator should properly adjust the A/C SEA, A/C RAIN and GAIN to be sure the alarm system does not overlook target echoes.

3.8 Watchman

The watchman function periodically transmits the radar for minute to check for targets in a guard zone. If it finds change in the zone from the previous transmission it sounds the radar continuously. This feature is useful when you do not need the radar's function continuously but want to be alerted to radar targets in a specific area.

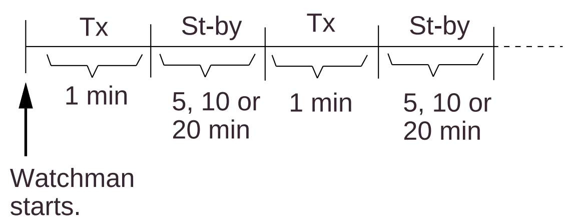


Figure 3-9 How watchman works

How watchman works

When the time selected for the watchman rest period has elapsed, the radar automatically transmits for one minute to check the condition inside the guard zone. If there is no change, the radar goes into stand-by ("WATCHMAN" appears during stand-by.) If there is change, the radar sounds the audible alarm, cancels the watchman function and transmits continuously.

Turning on watchman

1. Create a guard zone (usually 360 degrees) with the guard alarm function.
2. Press the [MENU] key.
3. Select "OTHER MENU".
4. Press the [ACQ/ENTER] key.
5. Select "15. Watchman".
6. Press the omnipad to select watchman rest period; 5 minutes, 10 minutes or 20 minutes.

"WATCHMAN" appears at the top of the screen, the radar transmits for one minute to check for targets inside the guard zone, and then the CRT shuts off and the radar goes into stand-by.

Cancelling watchman

Go into the "OTHERS" menu, and set "15. Watchman" for off.

Note 1: Watchman can be used without a guard zone.

Note 2: The alarm sounds just before the radar starts and stops transmitting.

3.9 Displaying Navigation Data

Navigation data can be displayed at the screen bottom if this radar receives navigation input in IEC 1162 format. Navigation data include

- position in latitude and longitude or Loran-C time difference
- range, bearing and time-to-go to both waypoint selected on the navigator and the cursor
- speed.

(If the navigation input includes destination data, waypoint position is denoted on the radar display by a dashed ring.)

To turn navigation data on or off;

1. Press the [MENU] key.
2. Select the "DISP DATA".
3. Press the [ACQ/ENTER] key.
4. Press the [ACQ/ENTER] key to select the message for Navigation display.
5. Prss the [ACQ/ENTER] key to set.
6. Press the [MENU] key to close the menu.

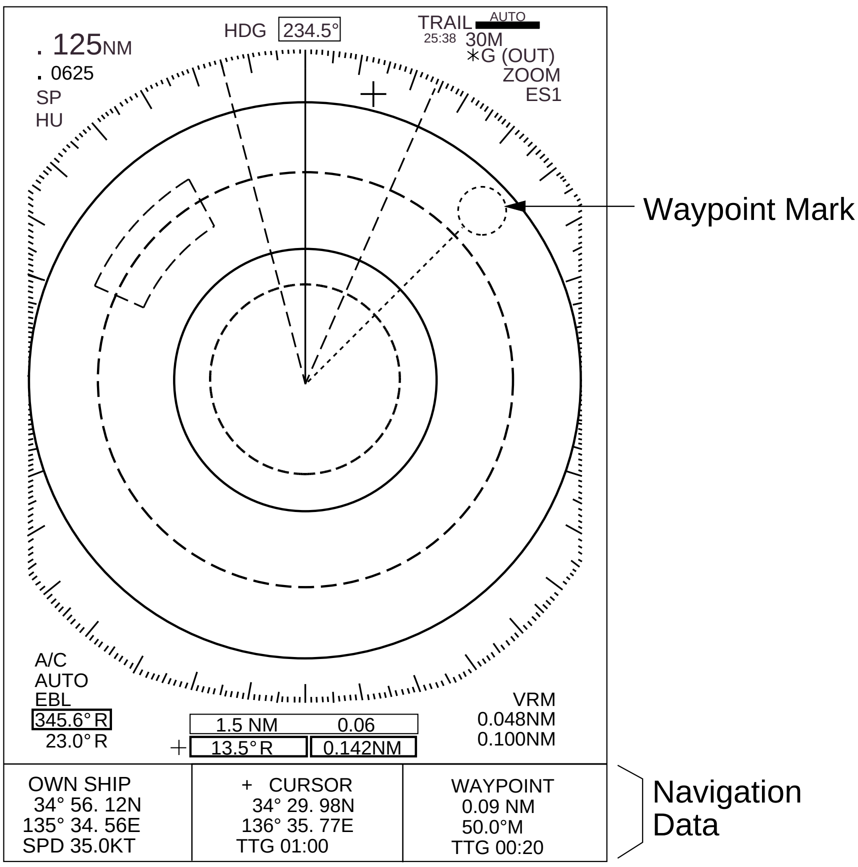


Figure 3-10 Typical navigation data display

3.10 OTHER MENU Description

The following summarizes the OTHER MENU.

Table 3-2 OTHER MENU Description

Item	Description
1. Panel Dimmer	Select level of panel backlight.
2. Mark Brill	Select brilliance of VRM, EBL, cursor, guard zone and WP marks.
3. HD Mark	Select brilliance of heading mark.
4. Charactors	Select brilliance of charactors.
5. Trail Tone	Select brilliance of echo trails.
6. Int Reject	Select level of interference rejection.
7. Pulselength	Select pulselength for 1.5 and 3 mile ranges.
8. Noise Reject	Select “On” to reject noise.
9. Trail Time	Select the trail time.
10. Tune	Select automatic or manual tuning. To tune manually; 1. Select “Menu” by the omnipad. 2. Press the [ENTER] key to enable manual tuning. 3. While pressing and holding down the [GAIN] control, operate the omnipad. 4. Press the [ENTER] key. “MANUAL” appears at the top right-hand corner when manual tuning is in effect.
11. Disp Data	Select the down sourse to display.
12. WPT Mark	Select “On” to display the waypoint mark.
13. EBL Ref	select EBL reference for relative or true.
14. VRM Unit	Select distance unit of VRM and cursor for nm, km or sm.
15. Watchman	Turn watchman on (set rest period) or off.
16. STBY Disp	Select the display on stand-by; display “STBY” or navigation data, or go into the economy mode.
17. Guard Mode	Select condition which triggers guard alarm; in or out.
18. Own Position	Display the cursor position in strength whitch trigger guard alarm.
19. Cursor Posi	Dispalay the cursor position in range/bearing or lat/long.
20. Alm sense LV	Select minimau echo strength which triggers guard alarm.
21. Dead Sector	Select “On” to display the dead sector.
22. Range	Select ranges in use.
23. Self Test	Test keys, ROM and RAM, check antenna rotation speed, and display program no.
24. Installation Setup	Go to the installation setup menu.

3.11 Function Keys

The function keys (F1 and F2) work like the auto-dialing feature of a telephone, automatically executing the function assigned to them. The function can be turned off by pressing appropriate function key again.

Default settings

F1: Shift (brief press) or Zoom (long press)

F2: Ring brillience

How to register menu items

1. Press the [MENU] key.
2. Press [A/C SEA] (F1) or [A/C RAIN] (F2) to open the function menu.



Figure 3-11 Function menu

3. Select function desired.
4. Press the [ACQ/ENTER] key.
5. Press the [MENU] key to close the menu.

3.12 Suppressing Noise

Electrical noise can be suppressed by turning on “8. NOISE REJ” on the OTHERS menu.

3.13 Adjusting Brilliance of Markers

“2. Mark Brill” on the OTHER menu adjusts the brilliance of markers such as the cursor.

3.14 Outputting Target Position

Target position data can be output to the navaid in IEC 1162 format. Press and hold down the [TLL] key to output the data. This function requires position data and heading signal.

4. FALSE ECHOES

Occasionally false echoes appear on the screen at positions where there is no target. In some cases the effects can be reduced or eliminated. The operator should familiarize himself or herself with the appearance and effects of these false echoes, so as not to confuse them with echoes from legitimate contacts.

4.1 Multiple Echoes

Multiple echoes occur when a short range, strong echo is received from a ship, bridge, or breakwater. A second, a third or more echoes may be observed on the display at double, triple or other multiples of the actual range of the target as shown in Figure 4-1. Multiple reflection echoes can be reduced and often removed by decreasing the sensitivity or properly adjusting the A/C SEA.

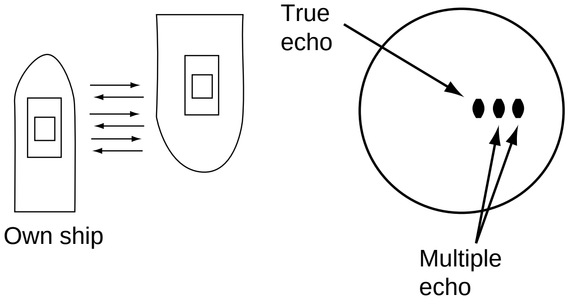


Figure 4-1 Multiple echoes

4.2 Side-lobe Echoes

Every time the antenna rotates, some radiation escapes on each side of the beam—called "side-lobes." If a target exists where it can be detected by the side-lobes as well as the main-lobe, the side-lobe echoes may be represented on both sides of the true echo at the same range, as shown in Figure 4-2. Side-lobes show usually only at short ranges and from strong targets. They can be reduced through careful reduction of the sensitivity or proper adjustment of the A/C SEA.

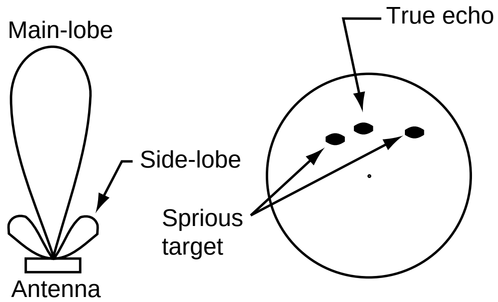


Figure 4-2 Side-lobe echoes

4.3 Indirect Echoes

Indirect echoes may be returned from either a passing ship or returned from a reflecting surface on your own ship, for example, a stack. In both cases, the echo will return from a legitimate contact to the antenna by the same indirect path. The echo will appear on the same bearing of the reflected surface, but at the same range as the direct echo. Figure 4-3 illustrates the effect of an indirect echo. Indirect echoes may be recognized as follows:

- they usually occur in a shadow sector
- they appear on the bearing of the obstruction but at the range of the legitimate contact
- when plotted, their movements are usually abnormal, and
- their shapes may indicate they are not direct echoes.

4.4 Blind and Shadow Sectors

Funnels, stacks, masts, or derricks in the path of antenna may reduce the intensity of the radar beam. If the angle subtended at the antenna is more than a few degrees a blind sector may be produced. Within the blind sector small targets at close range may not be detected while larger targets at much greater ranges may be detected. See Figure 4-4.

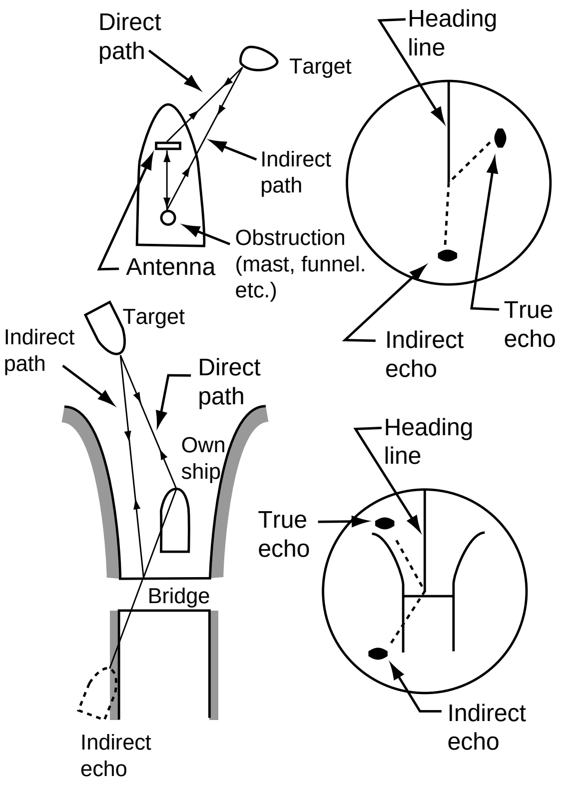


Figure 4-3 Indirect echoes

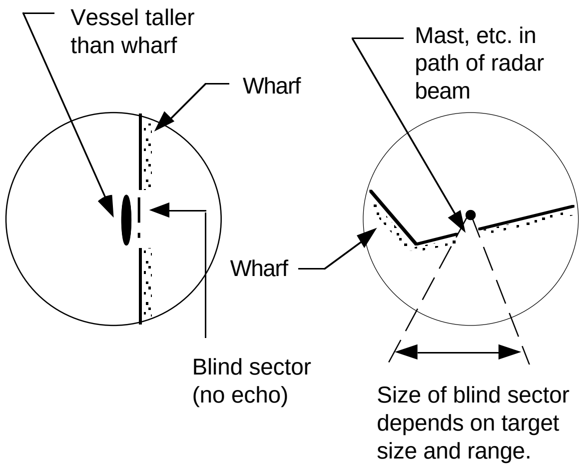


Figure 4-4 Blind and shadow sectors

5. MAINTENANCE & TROUBLESHOOTING

This chapter tells you how to keep your radar in good working order. Before reviewing this chapter please read the safety information which follows.

⚠ DANGER



Turn off the power before performing any maintenance or troubleshooting procedure.

Hazardous voltages can shock, burn or cause death. Only qualified personnel totally familliar with electrical circuits should work inside the units.

RF RADIATION HAZARD



The radar antenna emits high frequency radio radiation which can be harmful, particularly to your eyes.

Never look directly into the antenna from a distance of less than two feet when the radar is in operation as you could injure the cornea of your eyes. Always make sure the radar is set to stand-by or is turned off before starting work on the antenna unit.

5.1 Preventative Maintenance

Regular maintenance is important for good performance. Always keep the equipment as free as possible from dirt, dust, and water splashes. Make sure all screws securing the components are properly tightened.

A maintenance program should be established and should at least include the items listed in table 5-1.

5.2 Replacing the Fuse

The fuse in the power cable protects the equipment against reverse polarity or ship's mains, overcurrent, and equipment fault. If the fuse blows, find the cause before replacing it. Never use an incorrect fuse – serious damage to equipment may result and void the warranty.

12 V: 10 A fuse

24/32 V: 5 A fuse

Table 5-1 Recommended maintenance program

Period	Item	Check point	Remarks
3 to 6 months	Exposed nuts and bolts on antenna unit	Check for corroded or loosened nuts and bolts. If necessary, clean and repaint them thickly. Replace them if heavily corroded.	Sealing compound may be used instead of paint. Apply a small amount of grease between nuts and bolts for easy removal in future.
	Antenna radiator (1932/1942)	Check for dirt and cracks on radiator surface. Thick dirt should be wiped off with soft cloth dampened with fresh water. If a crack is found, apply a slight amount of sealing compound or adhesive as a temporary remedy, then call for	Do not use plastic solvent (acetone) for cleaning. If you need to remove ice from antenna unit, use a wooden hammer or plastic head hammer. Crack on the unit may cause water ingress, causing serious damages to internal
	Radome cover (1832)	Check for wear. Permanent damage to the antenna's internal circuitry will result if water leaks into the radome.	If a crack is found it should be temporarily repaired by using a small amount of sealing compound or adhesive. You should then contact your dealer for service.
6 months to 1 year	Display unit connectors	Check for tight connection and corrosion.	If corroded, contact your dealer for replacement.

5.3 Troubleshooting

Table 5-2 contains simple troubleshooting procedures which you can follow to try to restore normal operation. If you cannot restore normal operation, do not attempt to check inside any unit of the radar system. Any repair work is best left to a qualified technician.

Table 5-2 Troubleshooting table

If...	But...	Then...
you pressed the [POWER] key to turn on the radar	the control panel does not light	• try adjusting the control panel back-lighting on the OTHERS menu. • battery may have discharged. • check fuse in power cable.
	nothing appears on the display or display contrast is poor	• try adjusting the brilliance.
	characters are distorted	• request service.
the radar has warmed up and you pressed the [STBY TX] key to transmit	the antenna does not rotate	• the problem may be in antenna unit. Request service.
	characters and indications are abnormal	• have a qualified technician check the set.
you have adjusted the gain with A/C RAIN and A/C SEA off	neither noise nor targets appear (indications and markers do)	• check signal cable for damage.
	neither indications nor markers appear (noise and targets do)	• check signal cable for damage.
	the sweep (radial line sweeping around the display) is not synchronized with antenna rotation	• the problem may be in the antenna unit. Request service.
	there is no change in sensitivity	• request service.
a key is pressed	nothing happens	• key may be faulty. Request service.

5.4 Self Test

The self test facility checks the keyboard, ROM and RAM for proper operation.

1. Press the [MENU] key.
2. Select “OTHER MENU”.
3. Select “23. Self Test” and press the [ACQ/ENTER] key. The following display appears.

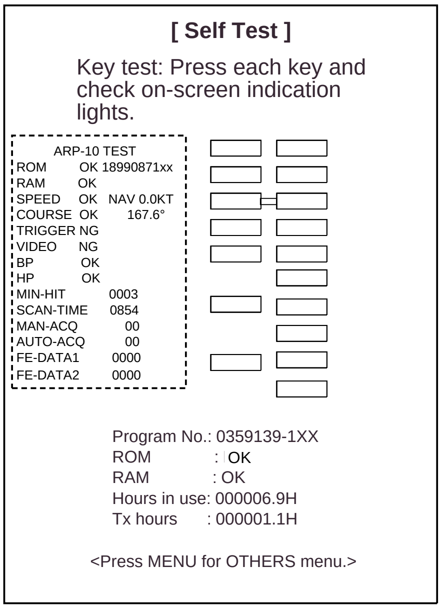


Figure 5-1 Self test screen

4. The ROM and RAM are automatically checked. If NG (No Good) appears to the right of ROM or RAM indication, contact your dealer for advice. ARP-10 TEST results appear only when optional ARP-10 board is mounted.
5. To check the keyboard, press any key except the omnipad, ACQ and power keys. Its corresponding location on the display lights in black if the key is operating properly.
6. Press the [ACQ] key to check the display circuit. The following pattern should appear.

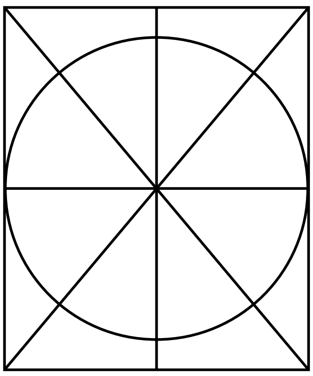


Figure 5-2 Test pattern

7. Press the [MENU] key to back to the selftest menu.
8. To escape from the test, press the [MENU] key.

5.5 Life Expectancy of Magnetron

The following table shows the life expectancy of the magnetron.

Table 5-3 Life expectancy of magnetron

Model	Type	Code no.	Life expectancy
1832/ 1932	E3571	000-137-527	2,000 - 3,000 hours (Including stand-by)
	MG5248	000-116-121	
	MAF1421B	–	
1942	E3560	000-139-050	
	MG5389	000-135-146	

6. INSTALLATION

This chapter provides the procedures necessary for installation. Installation mainly consists of the following:

- siting and mounting the display unit and antenna unit
- connection of the signal cable and the power cable
- establishing the ground
- checking the installation, and
- adjustments.

6.1 Antenna Unit Installation

Siting, handling considerations

- The antenna unit is generally installed either on top of the wheelhouse or on the radar mast on a suitable platform. Locate the antenna unit where there is a good all-round view rigging intercepting the scanning beam. Any obstruction will cause shadow and blind sectors. A mast for instance, with a diameter considerably less than the width of the radicator, will cause only a small blind sector, but a horizontal spreader or crosstrees in the same horizontal plane as the antenna unit would be a much more serious obstruction; you would need to place the antenna unit well above or below it.
- It is rarely possible to place the antenna unit where a completely clear view in all direction is available. Thus, you should determine the angular width and relative bearing of any shadow sectors for their influence on the radar at the first opportunity after fitting. (The method of determining blind and shadow sectors appears later in this chapter.)
- If you have a radio direction finder on your boat, local its antenna clear of the antenna unit, to prevent interference to the direction finder. A separation of more than two meters is recommended.
- To lessen the chance of picking up electrical interference, avoid where possible routing the signal cable near other onboard electrical equipment. Also avoid running the cable in parallel with power cables.
- The compass safe distance should be observed to prevent deviation of the magnetic compass.

Model	Standard compass	Steering compass
1832	0.9 m	0.7 m
1932	1.1 m	0.8 m
1942	1.0 m	0.74 m

- Do not paint the radome (Model 1832) or radiator aperture (Model 1932, 1942), to ensure proper emission of the radar waves.
- When this radar is to be installed on larger vessels, consider the following points:
  (1) The signal cable run between the antenna and the display comes in lengths of 10 m, 15 m, 20 m and 30 m. Whatever length is used it must be unbroken; namely, no splicing allowed.
  (2) Deposits and fumes from a funnel or other exhaust vent can adversely affect the aerial performance and hot gases may distort the radiator portion. The antenna unit must not be mounted where the temperature is more than 70°C.

Mounting (Model 1832)

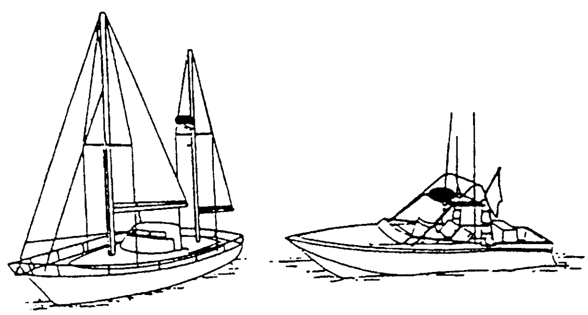


Figure 6-1 Typical antenna unit location

Unpacking the antenna unit

1. Open the antenna unit packing box carefully.
2. Unbolt the four bolts at the base of the radome to remove the radome cover.

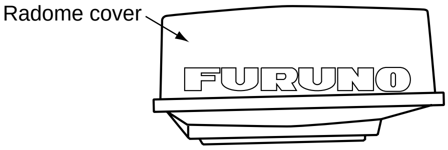


Figure 6-2 Antenna unit

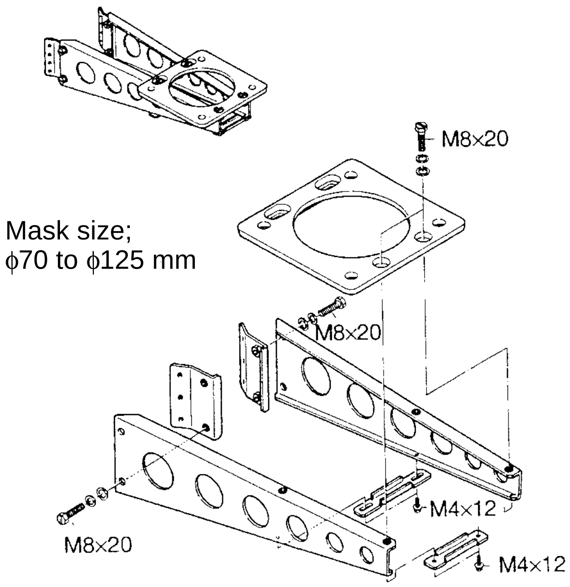
Mounting platform

Holes for antenna unit:

The mounting surface must be parallel with the waterline and provided with five holes whose dimensions are shown in the outline drawing attached at the end of this manual.

The unit is adjusted so a target echo returned from the bow direction will be shown on the zero degree (heading line) position on the screen. When drilling holes, be sure they are parallel with the fore and aft line.

3. Prepare a platform of 5 to 10 millimeters in thickness for the antenna unit. (A mounting bracket for mounting the antenna unit on a sailboat mast is optionally available. See the below for details.) Find the cable entry on the radome base. Next, position the radome base so the cable entry faces the stern direction. This alignment must be as accurate as possible. Fasten the radome base to the mounting platform with four each of M10 x 25 hex bolts, flat washers and spring washers.



Type: OP03-92
Code no.: 008-445-070

Figure 6-3 Assembling the sailboat mast mounting bracket (option)

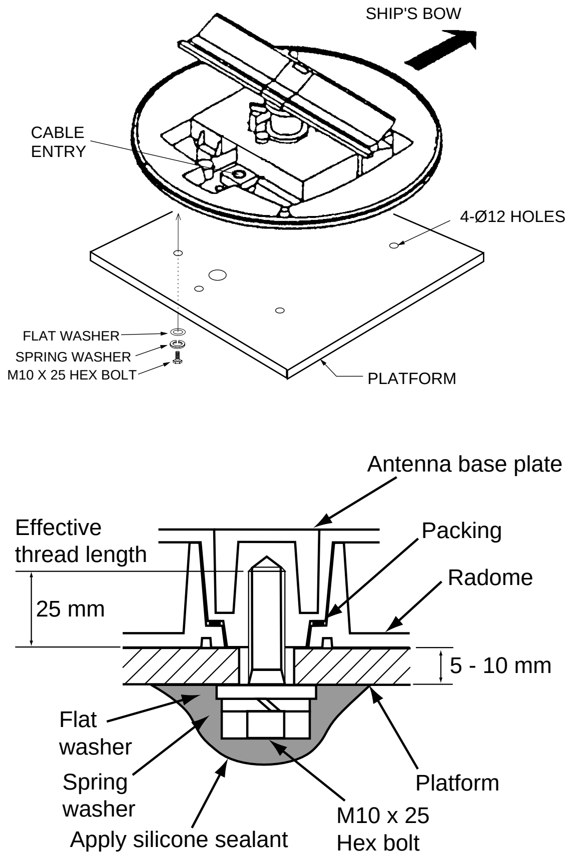


Figure 6-4 How to fasten the radome base to the mounting platform

Wiring and final preparation

4. Drill a hole of at least 20 millimeters diameter through the deck or bulkhead to run the signal cable between the antenna unit and the display unit. (To prevent electrical interference avoid running the signal cable near other electrical equipment and in parallel with power cables.) Pass the cable through the hole. Then, seal the hole with sealing compound for waterproofing.
5. Remove the shield cover in the radome.

6. Remove the cable clamping plate by unfastening four screws and removing a gasket.

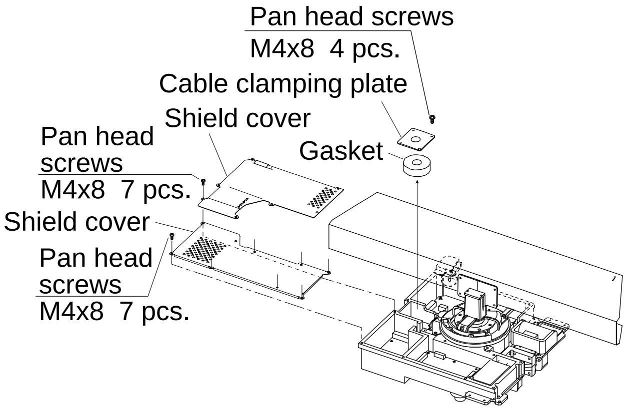


Figure 6-5 Antenna unit, inside view

7. Pass the cable through the hole at the bottom of the radome base.
8. Secure the cable with the cable clamping plate and gasket. Ground the shield and vinyl wire by one of the screws of the cable clamping plate.
9. Connect the wire to the RF unit.

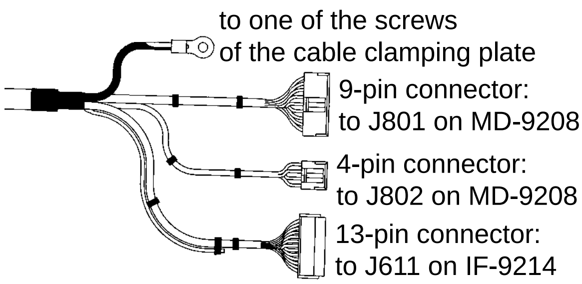


Figure 6-6 Signal cable, antenna unit side

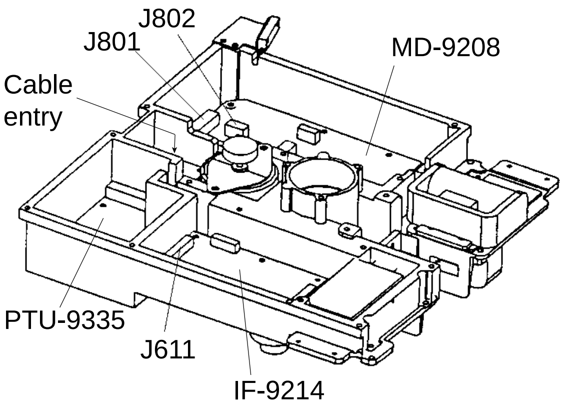


Figure 6-7 RF unit

10. Attach the EMC core supplied as shown below.

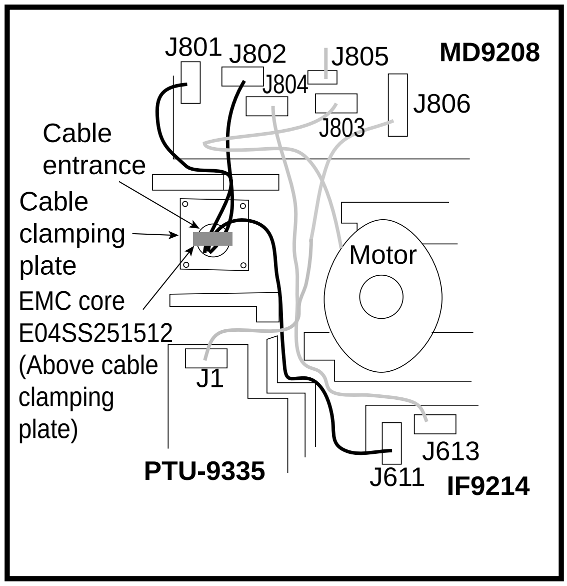


Figure 6-8 How to attach EMC core

11. Fix the shield cover. Do not pinch the cable.
12. Attach the radome cover, aligning triangle mark on radome cover with that on radome base.

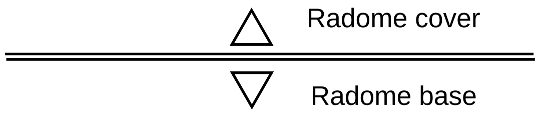


Figure 6-9 How to position the radome cover

13. Loosely fasten the radome fixing bolts. You will tighten them after confirming magnetron heater voltage.

Mounting (Model 1932, 1942)

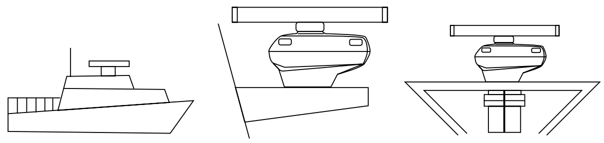


Figure 6-10 Typical antenna unit mounting locations

1. Drill four fixing bolt holes (13 millimeters dia.), one cable entry hole (approx. 50 millimeters dia.) in the mounting platform. See the outline drawing.

2. Detach the antenna housing cover from the antenna housing by loosening four fixing bolts. The antenna housing cover fitted with the transceiver module can be stored in a convenient place until the wiring to the antenna unit is done.

3. Place the antenna housing on the mounting platform and orient it as shown in Figure 6-11.

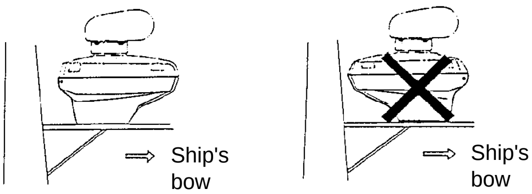


Figure 6-11 How to orient the antenna unit

4. Insert four M12 x 60 hex head bolts with the seal washers from inside the antenna housing, to prevent the bolts from contacting the transceiver module. Install the seal washer with the larger diameter next to the head of the bolt. Coat flat and spring washers and nuts and then use them to fasten the antenna housing to the mounting platform. Finally, coat exposed parts of nuts, bolts and flat and spring washers as shown in Figure 6-12.

Note: Tighten the bolts by their nuts to prevent damage to the seal washer. Do not turn the bolts to secure the antenna housing.

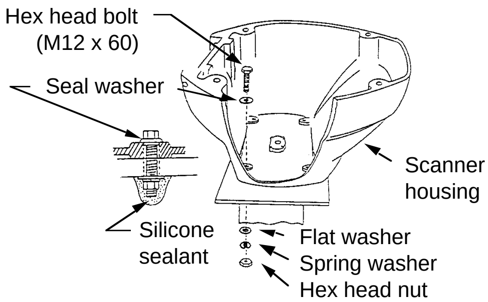


Figure 6-12 How to mount the antenna housing

Connections

Only the signal cable runs from the display unit to the antenna unit. Make the hole for passing the cable through the bulkhead or deck at least 20 millimeters diameter. In order to minimize the chance of picking up electrical interference, avoid where possible routing the signal cable near other onboard electrical equipment. Also, avoid running the cable in parallel with power cables. Pass the cable through the hole and apply sealing compound around the hole for waterproofing.

The procedure for connecting the signal cable to the antenna unit is as following.

1. Through a pipe or waterproof cable grand fitted on the wheelhouse top or bulkhead.

2. Unfasten four screws at bottom of the scanner base to remove the cable gland assembly.

3. Pass the signal cable through the antenna base and the cable gland assembly (removed in step 2.)

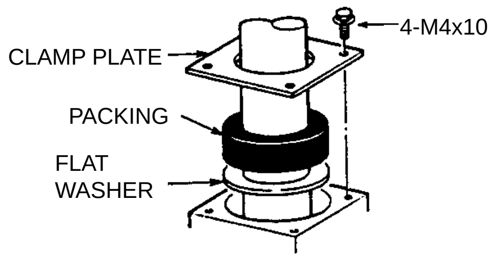


Figure 6-13 Passing the signal cable through the antenna housing

4. Fasten the cable gland assembly.

5. Connect the lead wires to RTB-9100 in the antenna housing by referring to the Interconnection Diagram. Fasten the ground washer at the bottom of the antenna housing as shown in Figure 6-13.

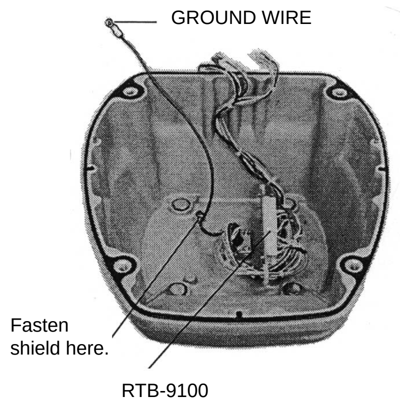


Figure 6-14 Connection in the antenna housing

Final preparation

1. Place the antenna housing cover on the housing. Loosely fasten the four fixing bolts on the cover.

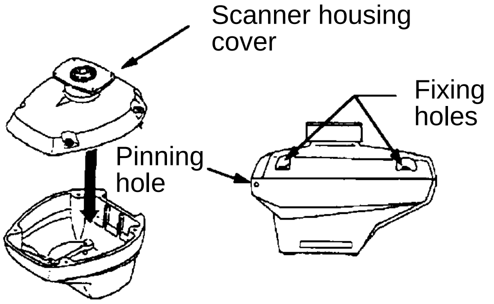


Figure 6-15 Fastening the antenna housing cover

2. Apply grease to the two slot pins. Using a wooden hammer to prevent damage to paint, insert slotted pins into the pinning holes until the pin head is flush with the scanner housing surface.

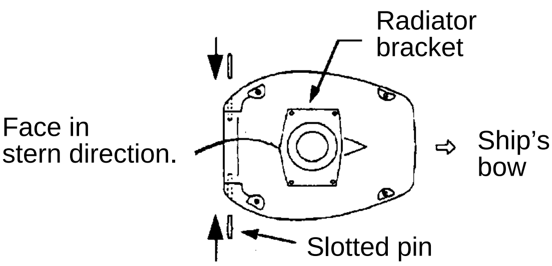
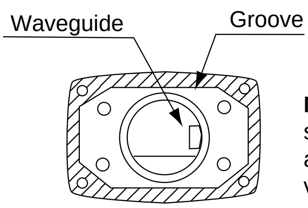


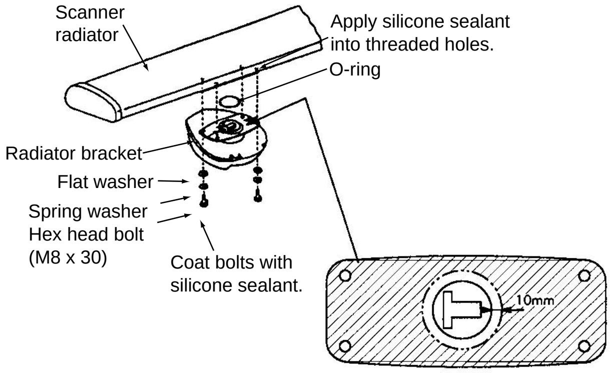
Figure 6-16 How to insert slot pins

3. Now is the time to fix the radiator to the radiator bracket. Apply anticorrosive sealant (silicone sealant) to hatched areas, to prevent corrosion. See the figure below. Apply silicone sealant into threaded holes on the scanner radiator. Remove the cap on the radiator bracket and orient the radiator bracket as shown in Figure 6-13. Apply grease to the O-ring and set it to the center of the radiator bracket. Coat the radiator fixing bolts with silicone sealant. Fasten the radiator to the radiator bracket <u>with the FURUNO logo on the radiator facing ship's bow.</u>



Note: Apply anticorrosive sealant to hatched areas, antenna radiator bottom view of XN8 type radiator.

Figure 6-17 How to coat radiator with silicone sealant for XN8 type radiator



Note: Apply anticorrosive sealant to hached areas, antenna bracket for XN12A type radiator.

Figure 6-18 Fastening the radiator to the radiator bracket

4. Open the antenna housing cover and fix the stay as shown in Figure 6-19.

5. One end of the cable with 15-, 9- and 7-way plugs has already been connected to RTB-9100 inside the scanner housing. Mate the 15- and 9-way plugs with jacks J812 and J811 on the transceiver module, respectively. Connect the 7-way plug to jack J701 on the MP Board. Secure the cable between RTB-9100 and J701 with the cable tie as shown in Figure 6-19.

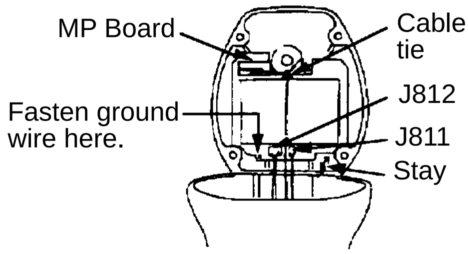


Figure 6-19 Antenna unit, cover opened

6. Fasten the ground wire (black) of the signal cable to the chassis as shown in Figure 6-19.

7. Loosely fasten the antenna housing cover. You will tighten the fixing bolts after confirming magnetron heater voltage.

6.2 Display Unit Installation

Mounting considerations

When selecting a mounting location for the display unit keep in mind the following points.

- Even though the display unit is waterproof, it is recommended that the display unit must be mounted inside an enclosed cabinet.
- Provide adequate space behind and around the unit to permit circulation of air and to provide convenient access to the rear connectors.
- Even though the picture is quite legible even in bright sunlight, keep the display unit out of direct sunlight or at least shaded because of heat that can build up inside the cabinet.
- Locate the display unit in a position where you can view and operate it conveniently but where there is no danger of salt or fresh water spray or immersion.
- The orientation of the display unit should be so the radar screen is viewed while the operator is facing in the direction of the bow. This makes determination of your position much easier.
- Make sure you allow enough clearance both to get to the connectors behind the unit and to allow you to get your hands in on both sides to loosen or tighten the mounting knobs. Make sure you leave at least a foot or so of “service loop” of cables behind the unit so it can be pulled forward for servicing or easy removal of the connectors.
- The compass safe distance of 0.8 meters (standard compass) and 0.6 meters (steering compass) should be observed to prevent deviation of the magnetic compass.
- Even though the display unit meets waterproof standard IPX-5, the connection of external buzzer, radar plotter and/or remote display can affect waterproofness. Watertight integrity cannot be guaranteed. When these modification has been done, the display unit should not be mounted where exposed.

Mounting

The display unit is designed to be mounted on a tabletop or bulkhead.

1. Using the hangar as a template, mark screw locations in the mounting location.
2. Fix the hanger to the mounting location with five M6 tapping screws (supplied).
3. Fit the knob bolts to the display unit. Install the display unit in the hunger. Tighten the knob bolts securely.

Connections

1. Connect the power cable to the power cable connector on the rear of the display unit.
2. Connect the signal cable to connector DJ-1 on the rear of the display unit.
3. Run a ground wire (local supply) between the ground terminal on the rear of the display unit and the ship’s superstructure.

Navigation aid, video sounder connection

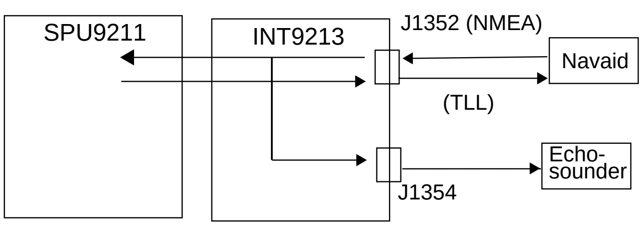
If your navigation aid can output data in IEC1162(NMEA 0183) data format, your vessel's position in latitude and longitude, the range and bearing to waypoint, speed and course may be input to this radar, and be seen on the screen.

Further if your video sounder can output depth in IEC1162 (NMEA 0183) data format, depth can be displayed on the radar screen.

You will need an NMEA cable:

Type	Code no.	Remarks
MJ-A6SPF0012-050	000-134-424	6P-6P (5m)
MJ-A6SPF0012-100	000-133-817	6P-6P (10m)
MJ-A6SPF0003-050	000-117-603	w/connector
MJ-A6SPF0009-100	000-125-236	w/connector

This radar can output NAV data received from a navaid to an echosounder.



1832/1932/1942

Heading Sensor Connection

Heading signal can be connected to the "HDG" connector.

Type	Code no.	Remarks
MJ-A6SPF0007-100	000-125-237	6P-6P 10m
MJ-A6SPF0009-100	000-125-236	w/connector(10m)
MJ-A6SPF0003-050	000-117-603	w/connector(5m)

Input/Output Data List

Model	Connector Name	Data	Pin	In/Out
FCV561M2	J1	183 (1.5)	4	In/Out
FCV581	NMEA	183 (1.5)	4	In/Out
FCV582	NMEA	183 (1.5)	4	In/Out
FCV291	NMEA	183 (1.5/2.0)	6	In/Out
FCV292	NMEA	183 (1.5/2.0)	6	In/Out
FCV668	NMEA	183 (1.5)	4	In/Out
GP1810	IN/OUT	183 (1.5/2.0)	6	In/Out
GP3100M2	IN/OUT	183 (1.5)	6	In/Out
GP8000M2	NMEA	183 (1.5/2.0)	4	In/Out
PS8000M2	NMEA	183 (1.5/2.0)	4	In/Out
GP80	DATA1	183 (1.5/2.0)	6	In/Out
GP80	DATA2	183 (1.5/2.0)	6	In/Out
GP1800M2	IN/OUT	183 (1.5/2.0)	6	In/Out

Note: All plotter in the table except the GP-1800M2 can receive TLL data.

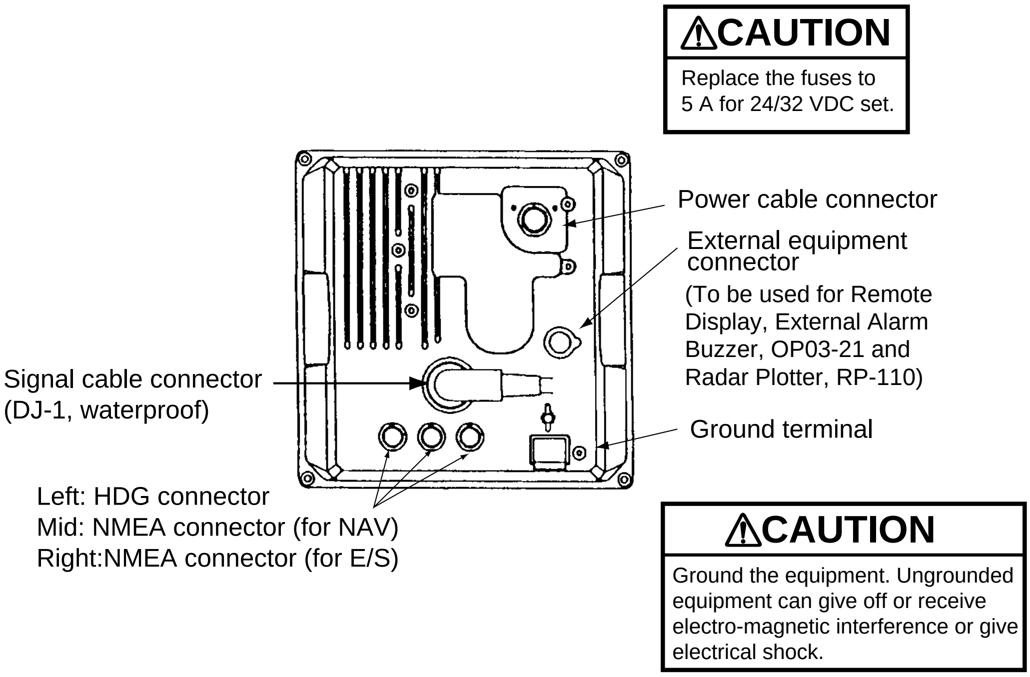


Figure 6-20 Connections on the display unit

6.3 Exchange of Fuse for 24/32V Power Supply

The power cable comes with a 10A fuse in the fuse holder. This fuse is for use with a 12V DC power supply. For 24V/32V DC power supply, replace the fuse with the 5A fuse (supplied) and attach 5A label (supplied) to fuse holder.

6.4 Checking the Installation

After completing the installation, it is a good idea to recheck it to be sure all steps were correctly done. Use the table 6-1 to check the installation.

Tick box

☐ The signal cable is securely retained against the mast or mounting platform and is free of interference from running rigging.

☐ The cable gland or entry on the deck, if provided, is waterproofed.

☐ The power connections to the battery are of correct polarity.

☐ The plugs at the rear of the display unit are tightly fastened.

☐ The fuse in the power cable is 10A (12V) or 5A (24V/32V DC).

6.5 Adjustments

This section covers adjustment of the radar after installation. You will need to

- adjust tune/video amplifier level input
- enter antenna height
- align heading
- adjust sweep timing
- adjust main bang suppression
- setting a blanking area, and
- confirm magnetron heater voltage.

These adjustments are done through the radar install menus.

Preparation

1. Turn off the radar. While pressing and holding down the [GAIN] control (at least three seconds), press the [POWER] key.
2. Press the [MENU] key, and select “OTHERS” by using the omnipad, and pressing [ACQ/ENTER] key.
3. Select “24. Installation setup”.
4. Press the [ACQ/ENTER] key to open the installation setup menu.

[Installation Setup]
Select item by omnipad
and ress ENTER key.

1. Nav Talker	All	GPS	LC
2 . Depth Unit	m	fa	ft
3 . Temp Unit	˚C	˚F	
4 . Hdg Sensor	Magnet	Gyro	
5 . Key Beep	Off	On	
6 . Ant on Tx	Rotate	Stop	
7 . Dead Sector	180˚~180˚		
8 . Tuned/Video Auto Adjustment			
9 . Heading Alignment			
10. Sweep Timing Adjustment			
11. MBS Adjustment			
12. Ant Height	Low	Mid	Hig
13. STC Curve	Sharp	Std	Gntl
14. Ope Mode	Master	Slave	
15. Hours in Use	000001.5H		
16. Tx Hours	000000.0H		

Figure 6-21 Installation setup menu

Adjusting tune/video

Do the following to adjust tune and video amplifier level input.

1. Press the [ST BY/TX] key to transmit.

⚠ WARNING

Before transmitting the radar make sure no one is near the antenna unit, to prevent the potential risk of being struck by the rotating antenna and exposure to RF radiation hazard.

2. On the Installation setup menu, select "8. Tune/Video Adjustment" and press the [ACQ/ENTER] key.
3. The unit automatically adjusts, displaying the following message.

[Tune/Video Auto Adjustment]

Now under correction.

Return to illustration setup.
menu after the correction.

Figure 6-22 Tune/Video Auto Adjustment messages

4. When adjustment is completed, the messages disappears.

Entering antenna height

The STC curve changes with respect to antenna height above the waterline. Enter antenna height above the waterline to optimize the STC curve.

1. Select "12. Antenna Height" on the installation setup menu and press the [ACQ/ENTER] key.
2. Operate the omnipad to select antenna height above the waterline; Low (~3 m), Mid (3~6 m) or High (6~10 m).
3. Press the [ACQ/ENTER] key.

Aligning heading (Adjustment sector:0~359.90)

You have mounted the antenna unit facing straight ahead in the direction of the bow. Therefore, a small but conspicuous target dead ahead visually should appear on the heading line (zero degrees).

In practice, you will probably observe some small error on the display because of the difficulty in achieving accurate initial positioning of the antenna unit. The following adjustment will compensate for this error.

1. Identify a suitable target (for example, ship or buoy) at a range between 0.125 to 0.25 nautical miles, preferably near the heading mark. To lessen error, keep echoes in the outer half of the picture by changing the range. Also, be sure the zoom and off center functions are off.
2. Select "9. Heading Alignment" on the installation setup menu and press the [ACQ/ENTER] key. The following message appears on the display.

[Heading alignment]
Set EBL1 to center of target
dead ahead and press ENTER.

Correction 0.0°

<Press MENU for inst setup>

Figure 6-23 Heading alignment message

3. Operate the omnipad to bisect target selected at step 1 with the heading line.
4. Press the [ACQ/ENTER] key.

5. As a final test, move the boat towards a small buoy and confirm that the buoy shows up dead ahead on the radar when it is visually dead ahead.

Adjusting sweep timing (Adjustment range:0.000~4.266nm)

This adjustment ensures proper radar performance, especially on short ranges. The radar measures the time required for a transmitted echo to travel to the target and return to the source. The received echo appears on the display based on this time. Thus, at the instant the transmitter is fired, the sweep should start from the center of the display (sometimes called sweep origin.)

A trigger pulse generated in the display unit goes to the antenna unit through the signal cable to trigger the transmitter (magnetron). The time taken by the signal to travel up to the antenna unit varies, depending largely on the length of signal cable. During this period the display unit should wait before starting the sweep. When the display unit is not adjusted correctly, the echoes from a straight local object (for example, a harbor wall or straight pier) will not appear with straight edges - namely, they will be seen as "pushed out" or "pulled in" near the picture center. The range of objects will also be incorrectly shown.

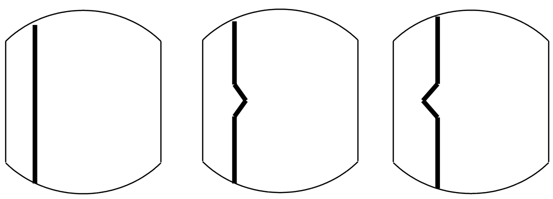


Figure 6-24 Examples of improper and correct sweep timing

1. Transmit on the shortest range and confirm that the [GAIN] and [A/C SEA] controls are properly adjusted.
2. Visually select a target which forms straight line (harbor wall, straight pier).
3. Select "10. Sweep Timing Adjustment" on the installation setup menu and press the [ACQ/ENTER] key. The message appears.

[Sweep Timing Adjustment]
Use omnipad to straighten
target and press ENTER key.

Correction 0.000 nm

<Press MENU for inst setup>

Figure 6-25 Sweep timing adjustment message

4. Operate the omnipad to straighten the target selected at step 2, and then press the [ACQ/ENTER] key.

Adjusting MBS (Adjustment: 0.00~0.25)

Main bang (black hole), which appears at the display center on short ranges, can be suppressed as follows.

1. Transmit on long range about 10 minutes.
2. Adjust the gain to show a small amount of noise on the display.
3. Change to the 0.125 nautical mile range and adjust the [A/C SEA] control.
4. Select "11. MBS adjustment" on the installation setup menu.
5. Press the [ACQ/ENTER] key. The following message appears.

[MBS Adjustment]
Set value by omnipad
and press ENTER key.

Correction 000

<Press MENU for inst setup>

Figure 6-26 MBS Adjustment message

6. Operate the omnipad to suppress main bang. (left: low, right: high, between 0 and 25)
7. Press the [ACQ/ENTER] key.

Setting a blanking area

When the antenna is installed at a close distance in front of the wheelhouse, the radar should be set not to transmit within that area. No echoes appear in the blanking areas.

1. Select "7. Dead Sector".
2. Press the [ENTER] key.
3. Operate the omnipad to enter starting point of area (in figures).
4. Press the [ENTER] key.
5. Operate the omnipad to enter ending point of area (in figures).
6. Press the [ENTER] key.

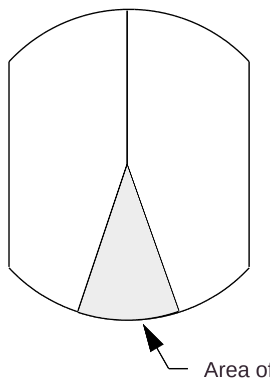


Figure 6-27 Blank areas where transmission is suspended

This area can be turned on/off on the OTHER MENU. For detail, see the description on page 18.

Note: This setting should be done after other adjustments are finished.

Magnetron heater voltage

Magnetron heater voltage is formed at the MD Board of the antenna unit and preadjusted at the factory for use with any length of signal cable. Therefore no adjustment is required. However, verify heater voltage by following the procedure below.

1. Turn on the radar (if it is not already on) and set it in stand-by.
2. Open the antenna housing (radome) cover. Connect a multitester, set to 10 V DC range.

Model	Check Point	Rating	Adjustment point
M1832	TP802 #4, #6 on PTU Board	7.4~7.6V	R106
M1932	TP803 #4, #6 on MD Board	7.4~7.6V	VR801
M1942	TP803 #4, #6 on MD Board	7.5~7.7V	VR801

3. Close the antenna housing cover and tighten the fixing bolts.

MENU TREE

- MENU KEY
  - RINGS (Off, 1, 2, 3, max)
  - EBL OFFSET (Off, On)
  - SHIFT (Off, On)
  - ZOOM (Off, On)
  - MODE (HU, CU, NU, TM)
  - DISP DATA
  - ECHO TRAIL (Off, On)
  - ECHO STRTCH (Off, ES1, ES2)
  - ARP-10 MENU
    1. Display
    2. All Cancel
    3. Vector ref
    4. Vector Length
    5. History
    6. CPA SET
    7. TCPA SET
    8. AUTO ACQ
  - OTHER MENU
    1. Panel Dimmer (1, 2, 3, 4)
    2. Mark Brill (1, 2, 3, 4)
    3. HD Mark (1, 2, 3, 4)
    4. Characters (1, 2, 3, 4)
    5. Trail Tone (Single, Multi)
    6. Int Reject (Off, 1, 2, 3)
    7. Pulselength (Short, Long)
    8. Noise Reject (Off, On)
    9. Trail Time (15S, 30S, 1M, 3M, 6M, 15M, 30M, Cont)
    10. Tone (Auto, Manu)
    11. Disp Data (Off, Nav, ARP, All)
    12. WPT Mark (Off, On)
    13. EBL Ref (Rel, True)
    14. VRM Unit (nm, km, sm)
    15. Watchman (Off, 5M, 10M, 20M)
    16. STBY DISP (Norm, Econo, Nav)
    17. Guard Mode (In, Out)
    18. Own Position (L/L, TD)
    19. Cursor Posi (B/R, L/L)
    20. Alm Sense LV (Low, Mid, High)
    21. Dead Sector (Off, On)
    22. Range (1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 16, 24,
        - 36) :1832
        - 36, 48) :1932
        - 36, 48, 64) :1942
    23. Self Test
    24. Installation Setup
        1. Nav Talker (All, GPS, LC)
        2. Depth Unit (m, fa, ft)
        3. Temp Unit (°C, °F)
        4. Hdg Sensor (Magnet, Gyro)
        5. Key Beep (Off, On)
        6. Scan Stop (Rotate, Stop)
        7. Dead Sector
        8. Tune/Video Adjustment
        9. Heading Alignment
        10. Sweep Timing Adjustment
        11. MBS Adjustment
        12. Ant Height (Low, Mid, high)
        13. STC Curve (Sharp, Std, Gntl)
        14. Ope Mode (Master, Slave)
        15. Hours in Use
        16. TX Hours

ARP-10 (OPTION)

⚠ WARNING



Hazardous voltage can shock, burn, or cause death.

Only qualified personnel should work in the unit.

This auto plotter is not designed to replace the human eye nor make decisions for the navigator. It is intended for use as an aid to navigation. Always maintain a watch while underway. Data obtained from this auto plotter should always be double checked against other sources to verify the reliability of the data.

This auto plotter automatically tracks a acquired radar target and calculates its course and speed, indicating it by a vector. Since the data generated by this unit are based on what radar targets are selected, the radar must always be optimally tuned for use with it to ensure that required targets will not be lost or unwanted targets such as sea returns and noise will not be acquired and tracked.

A target echo does not always mean a landmass, reef, ships or other surface objects but can imply returns from sea surface or precipitation. As the level of these returns varies with environment, the operator is required to properly adjust the STC (ant-clutter sea), FTC (anti-clutter rain) and GAIN controls to ensure that target echoes within the affected area are not eliminated from the radar screen. The optimum settings of these controls may slightly differ between the normal radar operation and plotting, and it is recommended to readjust them in accordance with the operating mode selected.

NOTICE

The installation must be done by a FURUNO representative or suitably qualified radar technician.

Authorities require this.

Keep magnets and magnetic fields away from the equipment.

Magnetic fields will distort the picture and can cause equipment malfunction. Be sure the unit is well away from equipment which gives off magnetic fields (speaker, power transformer, etc.).

The following items affect calculation accuracy.

- echo intensity
- radar transmission pulsewidth
- radar bearing error
- gyrocompass error
- own vessel or other vessel course change

Data for CPA, TCPA, etc. are approximations only. Always use data obtained prudently.

Operation of ARP-10

General

The Auto Plotter ARP-10 is an optional circuit board which is accommodated in the display unit of the MODEL 1832, 1932 and 1942 radars.

The Auto Plotter permits manual or automatic acquisition and automatic tracking of up to 10 radar targets. An internal microprocessor calculates target data such as speeds and courses and displays the results in alphanumeric and by vectors. To ensure the reliability of the displayed target data, the radar must be properly adjusted for minimum sea returns and noise.

Principal Specifications

Acquisition and tracking:

- Acquisition of up to 10 targets between 0.2 and 16 nm.
- Automatic tracking of up to 10 acquired targets between 0.1 and 16 nm.

Vectors:

Vector length; 30 s, 1, 3, 6, 15, 30 min.

Orientation; True velocity or relative velocity

Past positions: 5 past positions at intervals of 15, 30 s, 1, 2, 3, 6 min.

Alarm: Visual and audible alarms against targets violating CPA/TCPA limits, Visual alarm against lost targets

Target discrimination: A target measuring about 800 m or more in the radial or circumferential direction is regarded as a landmass and not acquired or tracked. Echoes smaller than about 800 m are regarded as true targets.

Keys Used for Auto Plotter

The Auto plotter utilizes the following touchpad keys. Given below is a brief description of these keys.

MENU: Displays/Erases the main menu.

SELECT/CANCEL:

(Long press) Terminates plotting of the target selected with the cursor.

(Brief press) Displays the data of target selected with the cursor.

ACQ/ENTER: Acquires the target selected with the cursor.

ARP-10 MENU Operation

The ARP-10 MENU operation includes the followings;

Display: Turns on/off the plot symbols, past positions and target data.

All Cancel: Cancels the tracking of all targets.

Vector Ref: Selects relative vector or true vectors. To select your choice, open the ARP-10 menu, and the legend Rel and True appear on the "3. Vector Ref" line. Operate the omnipad. When your selection is in the reverse video, press the [ACQ/ENTER] key.

Vector Length: Selects vector time.

History: Selects past position plot interval.

CPA Set: Selects CPA alarm limit. When a target is predicted to come within this limit, an aural alarm sounds and at the same time the corresponding target symbol changes to a blinking triangle.

Note:If the preset CPA limit is set at OFF, a target which is on collision course will not produce an alarm.

TCPA Set: Selects TCPA alarm limit.

Auto ACQ: Turns on/off Auto Acquisition Area.

Activating the Auto plotter

To activate the Auto Plotter, follow the steps shown below:

1. Adjust the GAIN, A/C SEA and A/C RAIN controls for proper radar picture.
2. Press the [MENU] key to open the main menu.
3. Operate the omnipad to select "ARP-10 MENU".
4. Press the [ACQ/ENTER] key. The menu shown in Figure AP-1 appears.

[ARP MENU]
Select item by omnipad
and press ENTER key.

1. Display	Off		On		
2 . All Cancel					
3 . Vector Ref	Rel		True		
4 . Vector Length			30S	1M	
	3M	6M	15M	30M	
5 . History	Off	15S	30S	1M	
	2M	3M	6M		
6 . CPA Set	Off	0.5	1nm	2nm	
	3nm	5nm	6nm		
7 . TCPA Set	30S	1M	2M	3M	
	4M	5M	6M	12M	
8 . Auto ACQ	Off		On		

Figure AP-1 ARP Menu

5. Operate the omnipad to select the menu item "1. Display".
6. Operate the omnipad to select "On".
7. Press the [ACQ/ENTER] key.
8. Press the [MENU] key to close the menu.

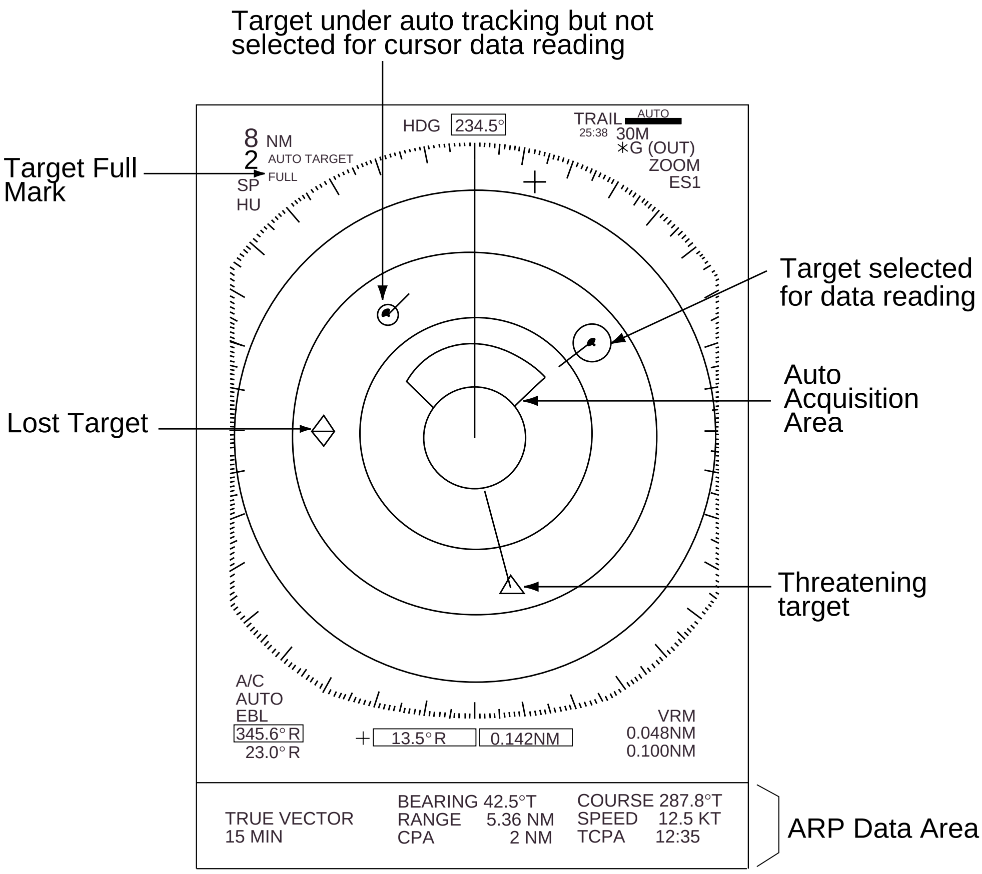


Figure AP-2 ARP Display

Deactivating the Auto Plotter

To deactivate the Auto Plotter,

1. Open the "ARP-10 MENU".
2. Operate the omnipad to select the "1. Display".
5. Operate the omnipad to select "Off".
6. Press the [ACQ/ENTER] key.
7. Press the [MENU] key to close the menu.

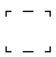
Acquiring targets

Manual Acquisition

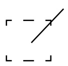
Follow the steps below to manually acquire a target. Up to 10 targets can be manually acquired.

1. Place the cursor (+) on a target of interest by operating the omnipad.
2. Press the [ACQ/ENTER] key.

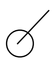
The plot symbol changes its shape according to the status as below. A vector appears in about one minute after acquisition indicating the target's motion trend. If the target is consistently detected for three minutes, the plot symbol changes to a solid mark. If acquisition fails, the target symbol blinks and disappears shortly.


SQUARE (dotted)

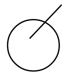
Immediately after acquisition - Plot symbol shown in broken lines.


SQUARE (dotted with a vector)

One minute after acquisition - Vector still unreliable.


CIRCLE (Solid with a vector)

3 minutes after acquisition - Plot symbol changes to a solid circle indicating the stable tracking condition.


LARGE CIRCLE

The plot symbol of a target under tracking becomes twice as large as the normal symbol when the target is selected for data reading.

Note 1:The target to be acquired should be within 0.2 to 16 nm from own ship and not obscured by sea or rain clutter for successful acquisition.

Note 2:When you want to acquire 11th target, cancel tracking one of less important targets.

Note 3:When auto acquisition mode (Auto ACQ) is on, up to 5 targets can be acquired. For detail, see next section titled Automatic Acquisition.

⚠ WARNING

When a tracked target nears another tracked target, the targets may be "swapped." When two targets come close to each other, one of the two can become a "lost target." Should this happen, reacquisition of the "lost target" is required after the two targets have separated.

Automatic Acquisition

The Auto plotter ARP-10 can acquire up to 5 targets automatically by setting the Auto Acquisition area predefined in the system. If Auto ACQ is selected after more than 5 targets have been manually acquired, only the remaining capacity of targets can be automatically acquired. Example; when 7 targets acquired manually, then the Auto ACQ is switched on only 3 targets can be acquire automatically. When five targets have been automatically acquired, "AUTO TARGET FULL" message appears at top left corner on the display.

Setting Auto Acquisition Area

Auto acquisition area is predefined between 2.0 and 2.5 nm in range and 45º on either side of the heading line in bearing. If a target come into this area, it is acquired automatically.

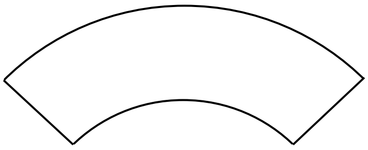


Figure AP-4 Auto acquisition area

Follow the steps shown below to activate the auto acquisition area;

1. Open the "ARP-10 MENU".
2. Select "8. Auto ACQ" by operating the omnipad.
3. Operate the omnipad to select "On".
4. Press the [ACQ/ENTER] key.
5. Press the [MENU] key to close the menu.

Terminating Tracking of Targets

When the Auto Plotter has acquired 10 targets, no more acquisition occurs unless targets are lost. Should this happen, cancel tracking of individual targets or all targets by the procedure described below.

Individual Targets

Place the cursor (+) on a target which you do not want to be tracked any longer by operating the omnipad and press and hold down the [SELECT/CANCEL] key.

All Targets

All targets can be canceled from "ARP-10 MENU" at a time.

1. Open the "ARP-10 MENU".
2. Select "2. All Cancel".
3. Press the [ACQ/ENTER] key.

Displaying Target Data

The Auto Plotter calculates motion trends (range, bearing, course, speed, CPA and TCPA) of all targets under tracking at the ARP Data area.

To turn ARP data on;

1. Press the [MENU] key.
2. Select the "DISP DATA".
3. Press the [ACQ/ENTER] key to select the message for "ARP" or "NAV and ARP ".
4. Press the [ACQ/ENTER] key to set.
5. Press the [MENU] key to close the menu.

⚠ CAUTION

At the speed under 5 kts the target data is displayed with a delay because of filtration.

Place the cursor on a wanted target and press the [SELECT/CANCEL] key. Data on the selected target is displayed at the bottom of the screen. The symbol of the selected target gets twice as large as the normal circle. The data includes the follows;

RNG/BRG (Range/Bearing): Range and bearing from own ship to the last-plotted or selected target position with suffix "T" (True) or "M" (Magnetic). For true bearings suffix "T" is used in case of gyrocompass input and suffix "M" is used in case of magnetic compass input.

COURSE/SPEED (Course/Speed): Course and speed are displayed for the last-plotted or selected target with suffix "T" (True) or "M" (Magnetic). For true bearings suffix "T" is used in case of gyrocompass input and suffix "M" is used in case of magnetic compass input.

CPA (Closest Point of Approach) is the closest range a target will approach to own ship. Do not mix it with the operator preset CPA alarm limit.

TCPA is the time to CPA measured with present speeds of own ship and the targets. Both CPA and TCPA are automatically calculated. When a target ship has passed clear of own ship, the CPA is displayed and the TCPA appears as "**.*". TCPA is counted up to 99.9 min. and beyond this it is indicated as TCPA>99.9 min.

Mode and length of Vectors

True or Relative Vector

Target vectors are displayed in relative or true mode. Own ship does not have a vector in relative mode.

Vector Length

From the ARP-10 MENU, Vector Length can be set to 30 seconds, 1, 3, 6, 15 or 30 minutes and the selected vector time is indicated on the screen.

The vector tip shows an estimated position of the target after the selected vector time elapses. It can be valuable to extend the vector length to evaluate the risk of collision with any target.

Past position Display

The Auto Plotter displays equally time-spaced dots (maximum 5 dots) marking the past positions of any targets being tracked.

If a target changes its speed, the spacing will be uneven. If it changes the course, its plotted course will not be a straight line in TM mode.

Operational Warnings

There are two main situations which cause the Auto plotter to trigger visual and audible alarms.

- CPA/TCPA alarm
- Lost target alarm

CPA/TCPA Alarm

Visual and audible alarm are generated when the predicted CPA and TCPA of any target become less than their preset limits. The audible alarm continues for 10 seconds.

The Auto plotter ARP-10 continuously monitors the predicted range at the Closest Point of Approach (CPA) and predicted time to CPA (TCPA) of each tracked target to own ship.

When the predicted CPA of any target becomes smaller than a preset CPA alarm range and its predicted TCPA less than a preset TCPA alarm limit, the ARP-10 releases an audible alarm. In addition, the target plot symbol changes to a triangle and flashes together with its vector.

Provided that this feature is used correctly, it will help prevent the risk of collision by alerting you to threatening targets. It is important that GAIN, A/C SEA, A/C RAIN and other radar controls are properly adjusted and the Auto Plotter is set up so that it can track targets effectively.

CPA/TCPA alarm ranges must be set up properly taking into consideration the size, tonnage, speed, turning performance and other characteristics of own ship.

> ⚠ **WARNING**
>
> The CPA/TCPA alarm feature should never be relied upon as a sole means for detecting the risk of collision.
> The navigator is not relieved of the responsibility to keep visual lookout for avoiding collisions, whether or not the radar or other plotting aid is in use.

Follow the steps shown below to set the CPA/TCPA alarm ranges:

1. Open the "ARP-10 MENU".
2. On the "CPA Set" line, select a CPA limit desired. (Off, 0.5, 1, 2, 3, 5, 6 nm)
3. Press the [ACQ/ENTER] key.

4. On the "TCPA Set" line, select a TCPA limit desired. (30s, 1, 2, 3, 4, 5, 6, 12M)
5. Press the [ACQ/ENTER] key.
6. Press the [MENU] key to close the menu.

The flashing of the triangle plot symbol and vector remain on the screen until the dangerous situation is no longer present or you intentionally terminate tracking of the target by using the [SELECT/CANCEL] key.

Lost Target Alarm

When the system detects a loss of a tracked target, the target symbol becomes a flashing diamond.

Installation of ARP-10

Necessary Parts

ARP-10 (000-086-852)

Name	Type	Code No.	Qty
ARP-10 Board	18P9007	008-476-930	1
Spacer	SQ-20	000-801-650	3
Spring Washer	M3 C5191W	000-864-204	3
Pan Head Screw	M3x8 C2700W	000-881-404	3
Pan Head Screw (w/washer) *	3x8 SWRM10	000-805-774	3

* Not used.

Mounting (For technician only)

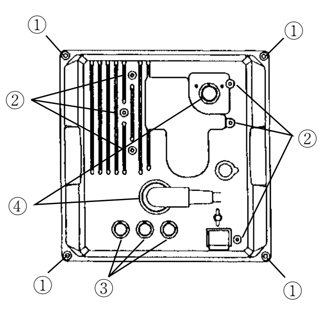
1. Remove the cover from the display unit as follows.

   ① Unscrew four binding screws (M4 x 10).

   ② Unfasten six binding screws (M3 x 10).

   ③ Remove three rubber covers to loosen three hex nuts.

   ④ Loosen two hex nuts.

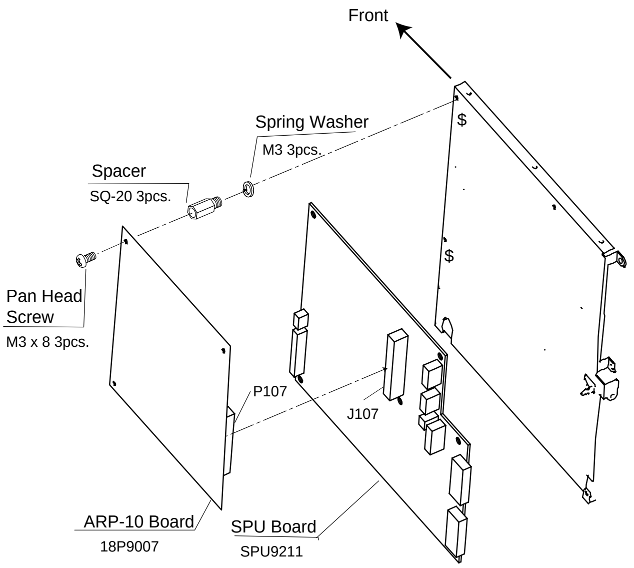


2. Attach the ARP-10 Board to the right-hand chassis of the display unit, using the spacer supplied as follows.

   1) Fasten three spacers tightly.

   2) Attach the P107 connector on ARP-10 Board to J107 connector on SPU Board.

   3) Tighten three pan head screws to fix the ARP-10 Board.



$: Pull the front panel slightly to fix these screws.

Input Signal Check

Place the radar in transmit condition after connecting the speed and heading sensor. Make sure the following items are OK on Self Test menu.

- SPEED
- COURSE
- TRIGGER

Video Signal Check

Make sure the follows on Self Test menu.

- VIDEO : OK
- Adjust GAIN, A/C SEA and A/C RAIN so that the readout for FE-DATA 1 and 2 are less than 1,000.

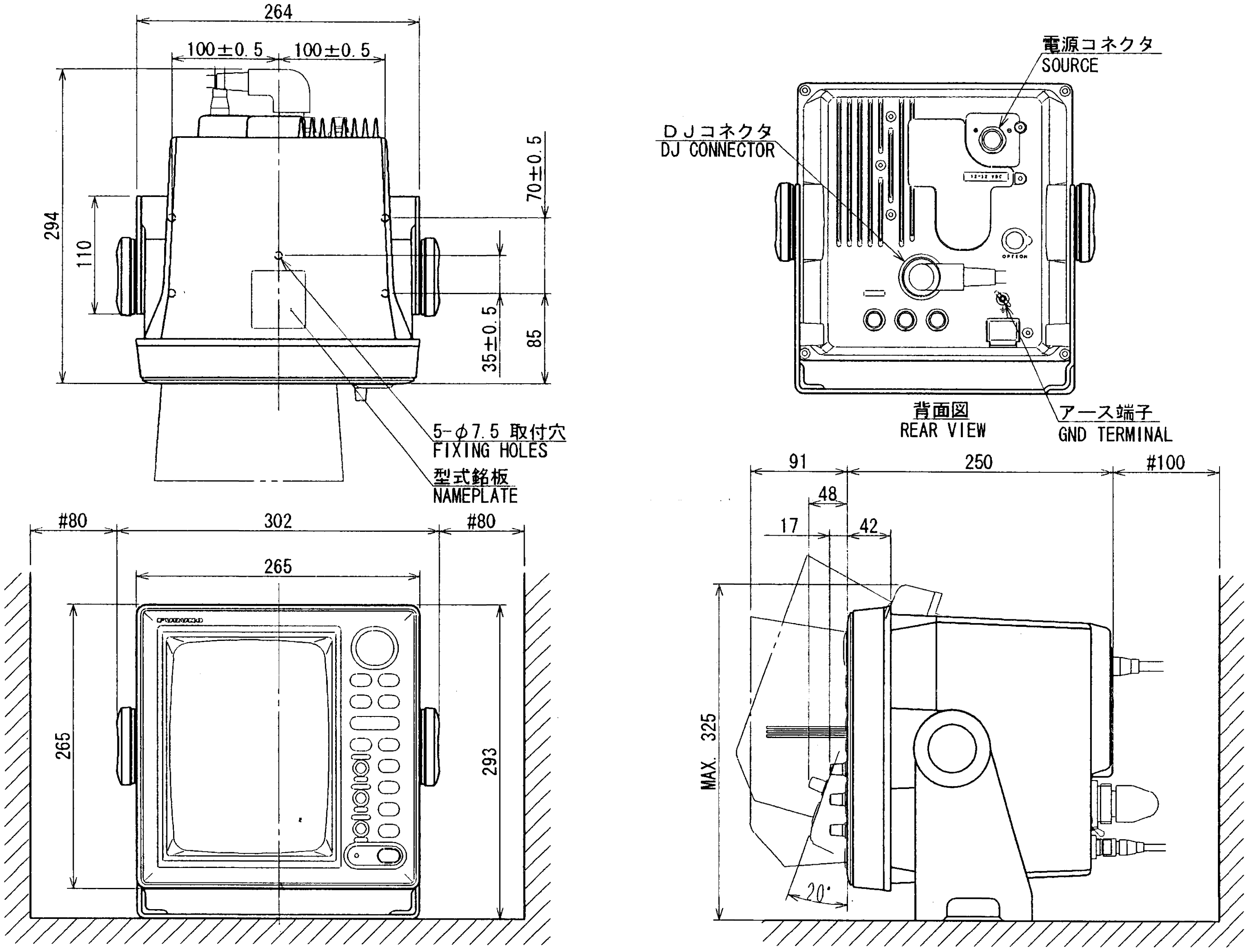


表1 TABLE 1

寸法区分(mm) DIMENSION	公差(mm) TOLERANCE
0 < L ≦ 50	±1.5
50 < L ≦ 100	±2.5
100 < L ≦ 500	±3

注 記
1) #印寸法は最小サービス空間寸法とする。
2) 指定外の寸法公差は表1による。
3) 取付用ネジはトラスタッピンネジ呼び径6×20を使用のこと。

NOTE
1. #: RECOMMENDED SERVICE CLEARANCE.
2. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS.
3. USE TAPPING SCREWS 6x20 FOR FIXING THE UNIT.

DRAWN Nov 9 '00 T.YAMASAKI		TITLE	RDP-118/135
CHECKED Nov 9 '00 Y.K	MODEL 1941R M2	名称	指示部
APPROVED Nov 9 '00 Y.K	MODEL 1932M2/1942M2 MODEL 1832/1932/1942		外寸図
SCALE 1/6	MASS 7.7 kg ±10%	NAME	DISPLAY UNIT
DWG. No. C3441-G04- F	03-136-100G- 4		OUTLINE DRAWING

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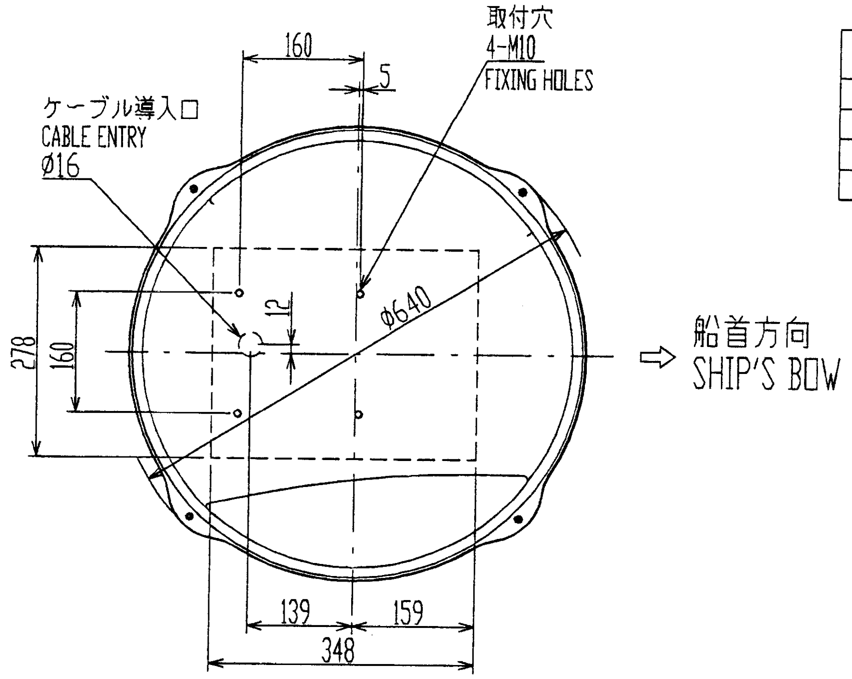
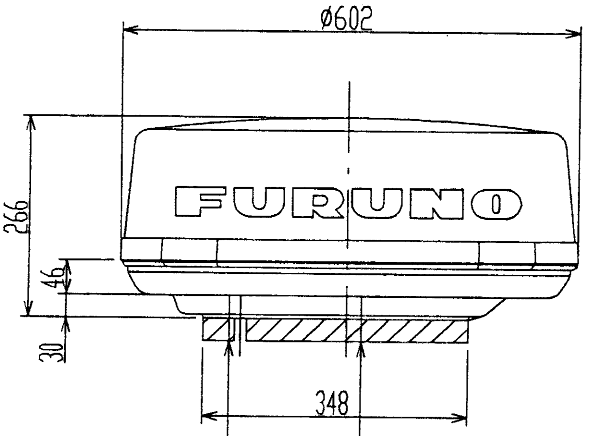
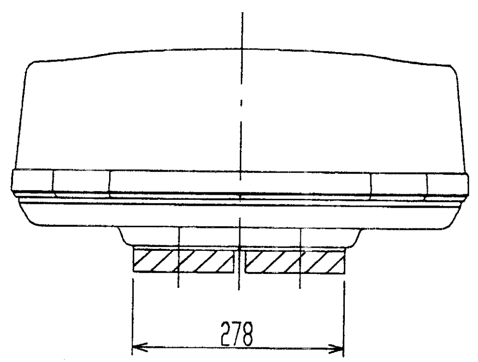
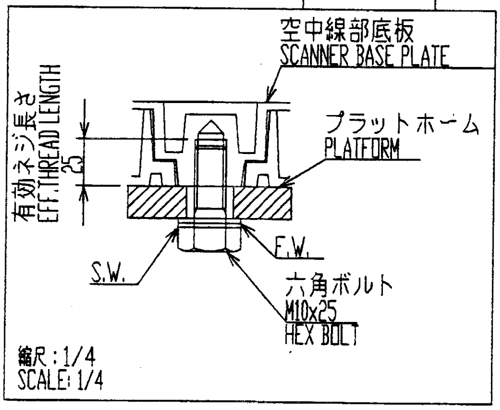


表1 TABLE 1

寸法区分(mm) DIMENSION	公差(mm) TOLERANCE
0 ＜ L ≦ 50	±1.5
50 ＜ L ≦ 100	±2.5
100 ＜ L ≦ 500	±3
500 ＜ L ≦ 1000	±4





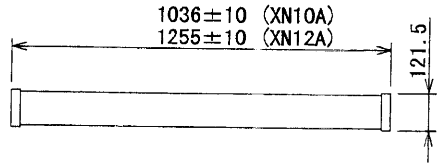


注記
1）指定外の寸法公差は表1による。
TABLE 1 INDICATES TOLERANCE OF DIMENSIONS.
2）コンパス安全距離
COMPASS SAFE DISTANCE.

スタンダード STANDARD	1.4 m
ステアリング STEERING	1.1 m

DRAWN Sep. 21 '01 T.YAMASAKI		TITLE	RSB-0071
CHECKED Sep. 21 '01 Y. Kimi	MODEL 1833/1833C MODEL 1732/1732C	名称	空中線部
APPROVED Sep. 21 '01 Y. Kimi	RS-1000 MODEL 1832		外寸図
SCALE 1/10 MASS 8 kg ±10%		NAME	SCANNER UNIT
DWG.No. C3441-G01-E	03-136-6001-G2		OUTLINE DRAWING

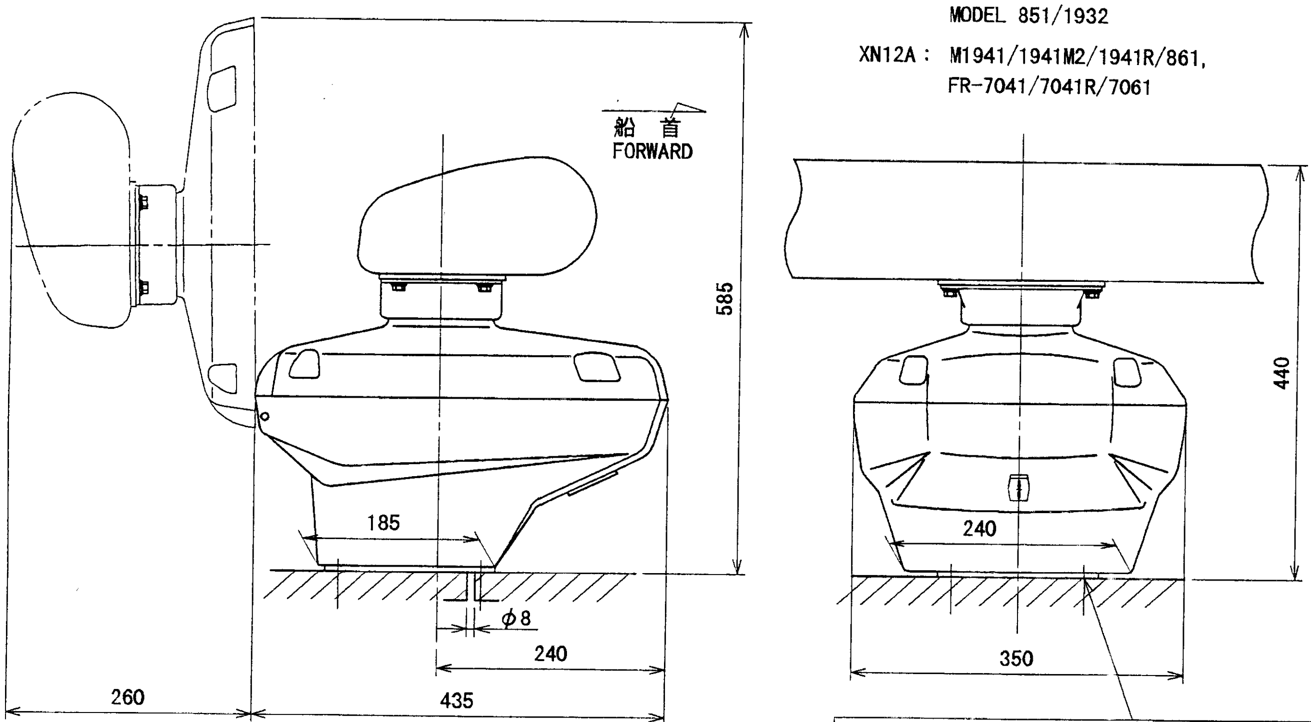
FURUNO ELECTRIC CO., LTD.

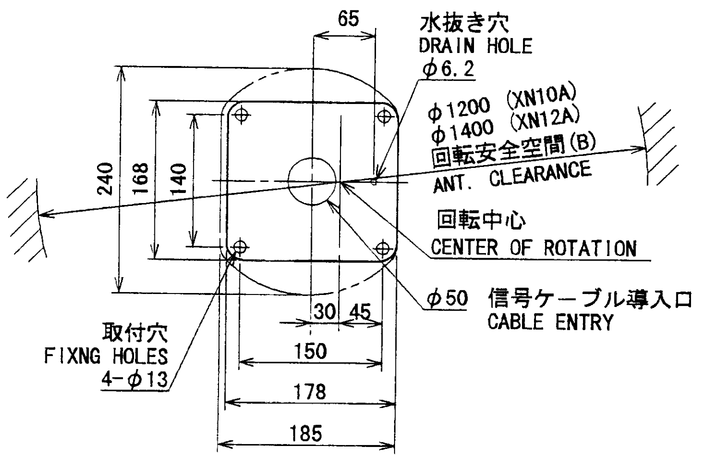


輻射器 RADIATOR (SCALE: 1/25)

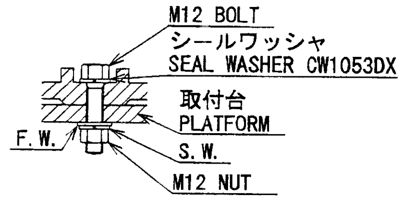
XN10A : M1761/1761M2/1931/1931M2
MODEL 851/1932

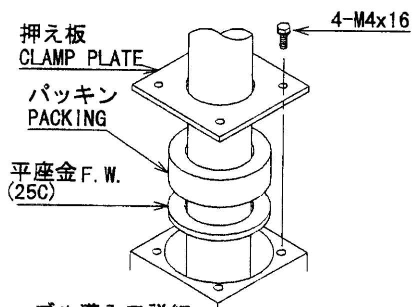
XN12A : M1941/1941M2/1941R/861,
FR-7041/7041R/7061





取付寸法
MOUNTING DIMENSIONS





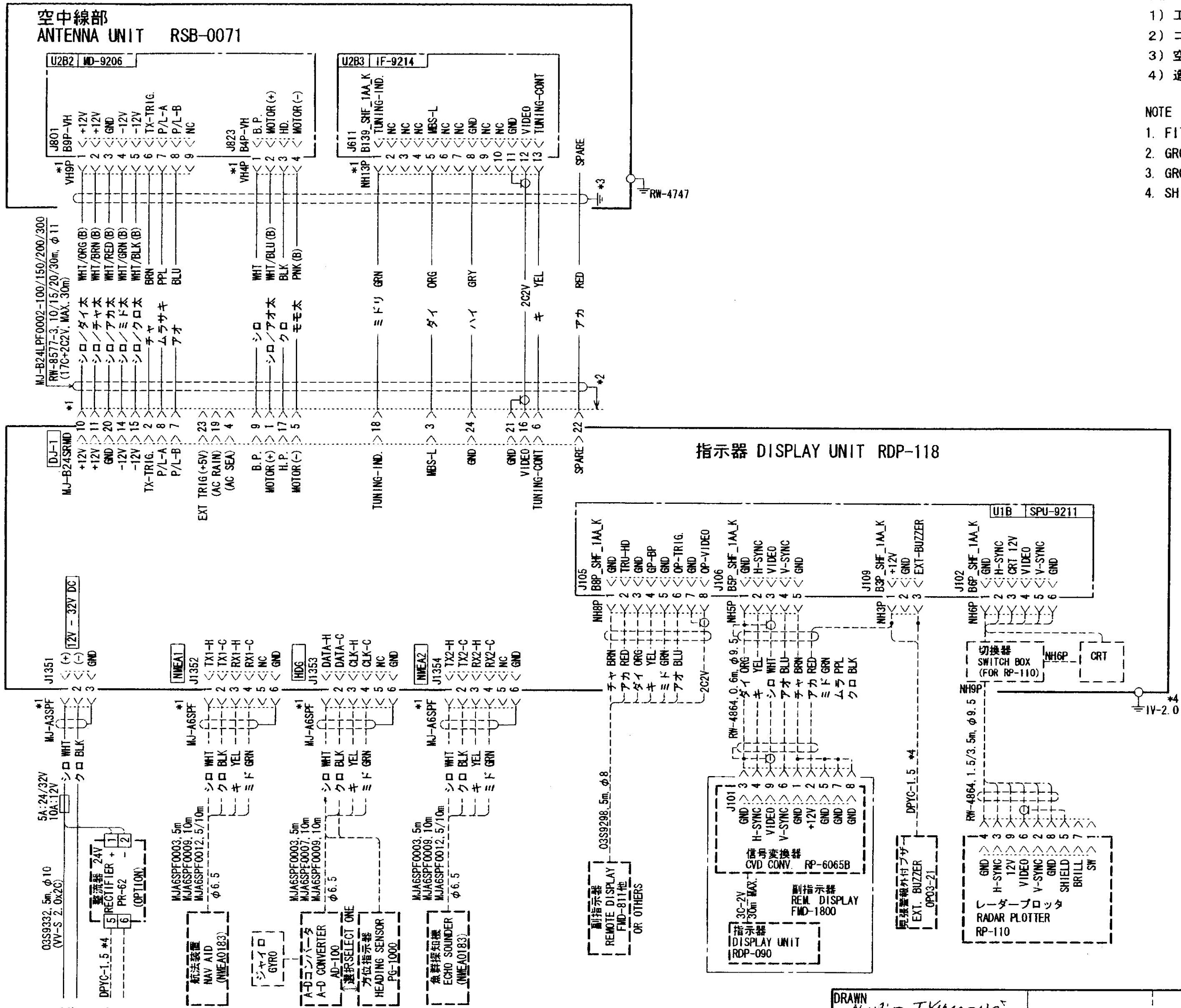
ケーブル導入口詳細
DETAIL OF CABLE ENTRY

質量 XN10A: 21.8 kg±10%
MASS XN12A: 20.0 kg±10%

DRAWN Apr. 19 '01 T. YAMASAKI	TITLE	XN10-RSB0062, XN12A-RSB0062/065
CHECKED Apr. 23 '01 Y. Kima	名称	空中線部
APPROVED APR. 24 '01 S. Yoshimura		外寸図
SCALE 1/8 MASS ±10% kg	NAME	ANTENNA UNIT
DWG. No. C3380-G01- H		OUTLINE DRAWING

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FURUNO

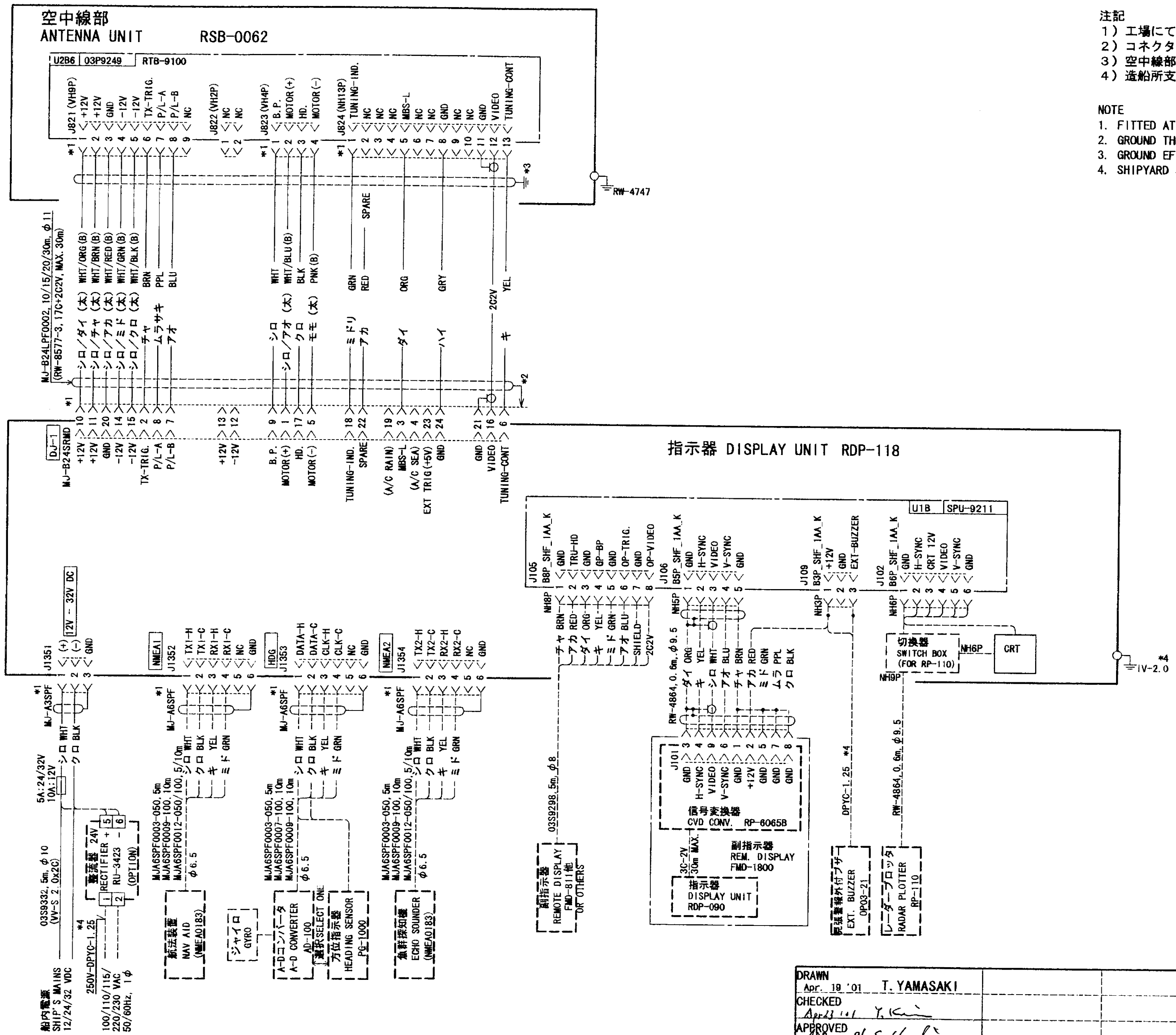


注記
1）工場にて取付済み。
2）コネクタのクランプでアースする。
3）空中線部のシールドは完全にアースする。
4）造船所手配。

NOTE
1. FITTED AT FACTORY.
2. GROUND THRU CONNECTOR CLAMP.
3. GROUND EFFECTIVELY AT SCANNER UNIT.
4. SHIPYARD SUPPLY.

DRAWN Nov 1 '00 T.YAMASAKI		TITLE	MODEL 1832
CHECKED Nov 9 '00 Y.K		名称	船舶用レーダー
APPROVED Nov 9 '00 Y.K			相互結線図
SCALE	MASS kg	NAME	MARINE RADAR
DWG No. C3441-C01-J	03-136-6001-0		INTERCONNECTION DIAGRAM

FURUNO ELECTRIC CO., LTD.



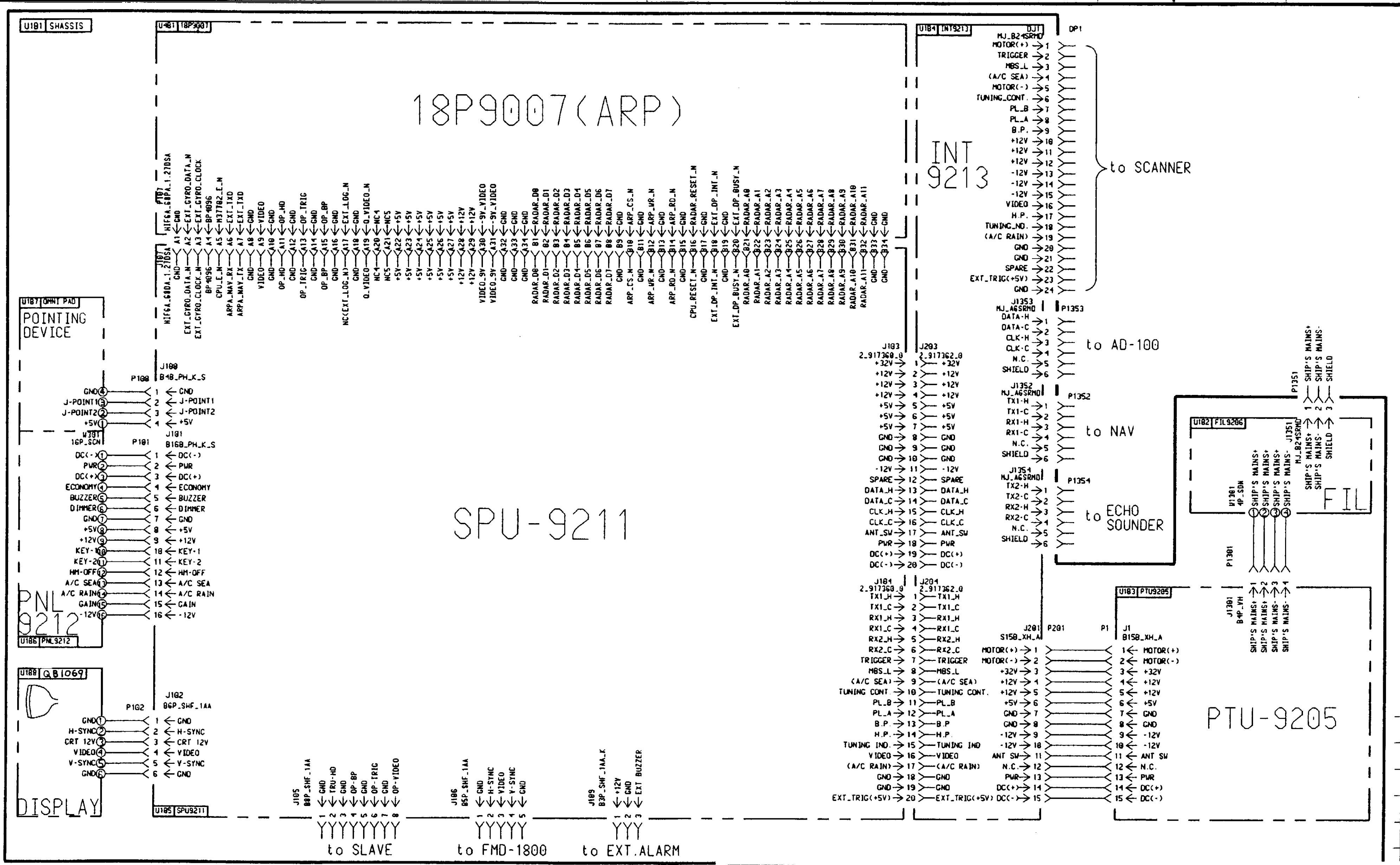
注記
1）工場にて取付済み。
2）コネクタのクランプでアースする。
3）空中線部のシールドは完全にアースする。
4）造船所支給。

NOTE
1. FITTED AT FACTORY.
2. GROUND THRU CONNECTOR CLAMP.
3. GROUND EFFECTIVELY AT SCANNER UNIT.
4. SHIPYARD SUPPLY.

DRAWN Apr. 19 '01	T. YAMASAKI	TITLE	MODEL 1932/1942
CHECKED Apr. 23 '01	Y. K	名称	船舶用レーダー
APPROVED APR. 26 '01	S. Y		相互結線図
SCALE	MASS kg	NAME	MARINE RADAR
DWG No.	C3442-C01- L	03-136-6002-1	INTERCONNECTION DIAGRAM

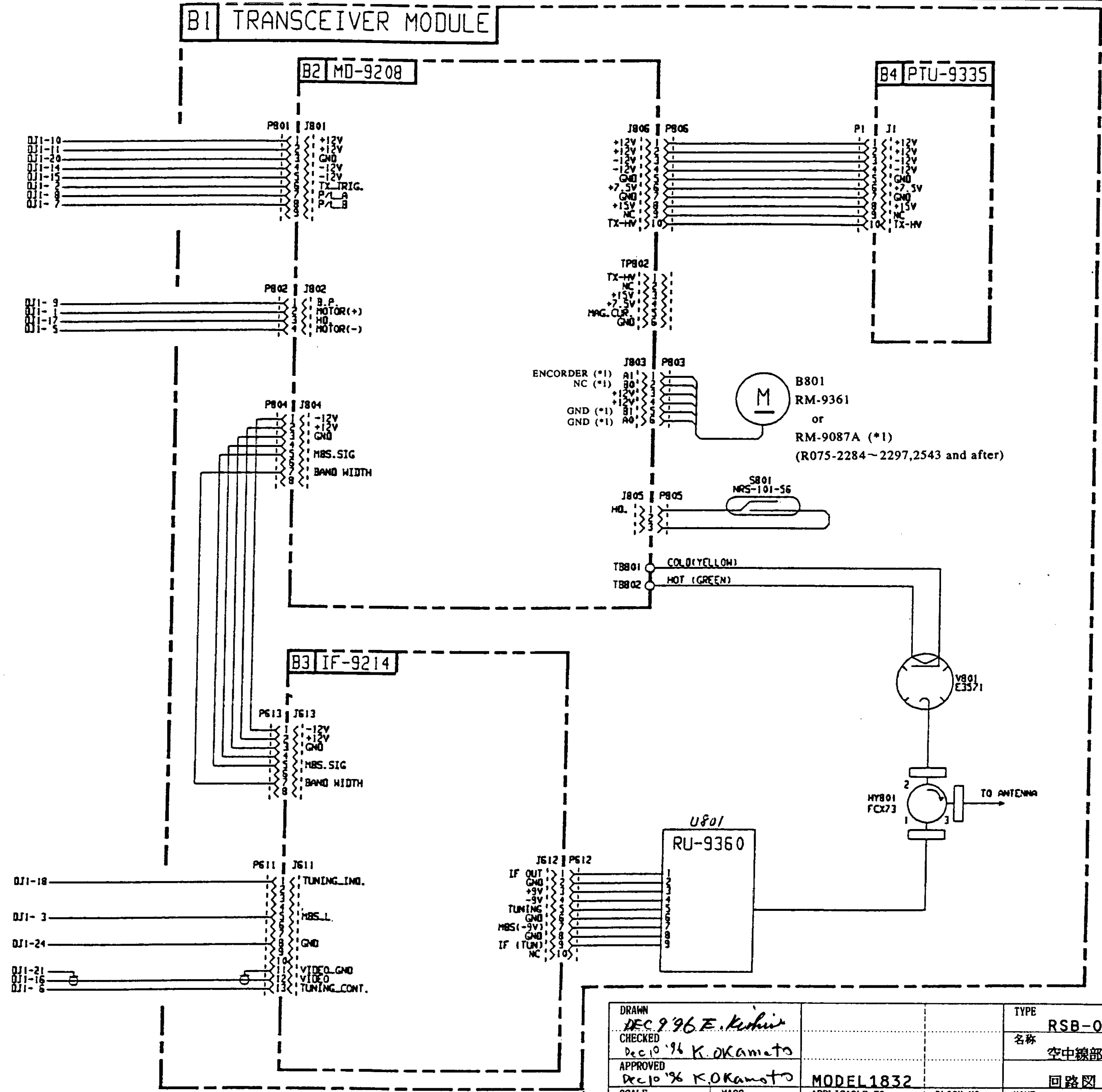
FURUNO ELECTRIC CO., LTD.

S - 3



DRAWN	Jun.16'98 T.Yamasaki	M1942M2		TYPE	RDP-118
CHECKED	Jun.16'98 K.Kusunoki	M1932M2		名称	指示部総合
APPROVED	Jun.16'98 K.Kusunoki	MODEL1942 MODEL1932 MODEL1832			回路図
SCALE /	MASS kg	APPLICABLE TO; (MODEL)	BLOCK NO.	NAME	DISPLAY UNIT
DWG NO.	C3441-K01- C	03-136-6004- 3			SCHEMATIC DIAGRAM

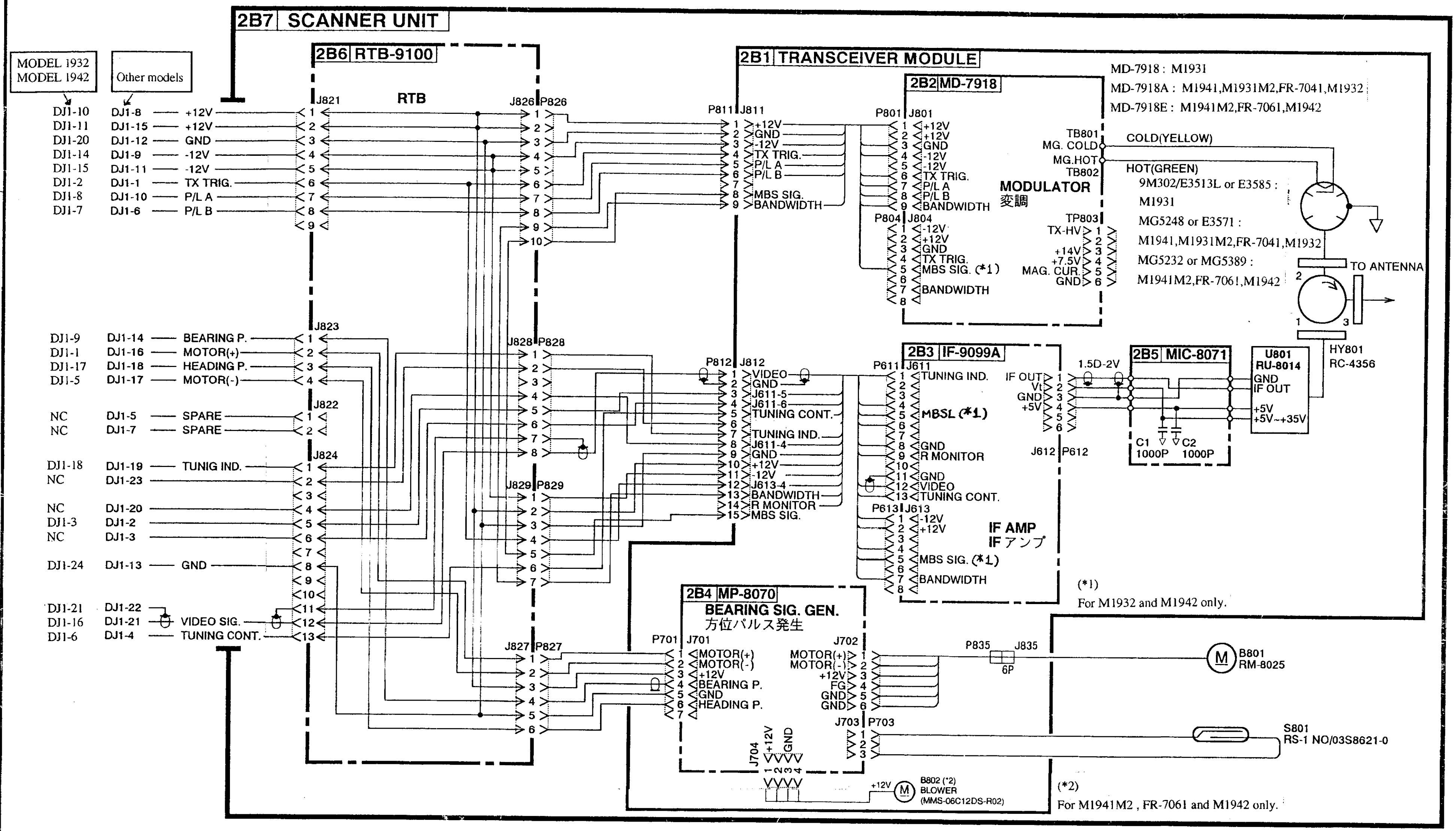
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DRAWN DEC. 9 '96 E. Kishi			TYPE	RSB-0071
CHECKED Dec. 10 '96 K. Okamoto			名称	空中線部
APPROVED Dec. 10 '96 K. Okamoto	MODEL1832			回路図
SCALE /	MASS kg	APPLICABLE TO: (MODEL)	BLOCK NO.	NAME SCANNER UNIT
DWG NO. C3441-K06- B	03-136-6005- 1			SCHEMATIC DIAGRAM

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DRAWN Apr 20 '01 T.YAMASAKI	FR7041/61 M1932/42 M1941M2 M1931M2 MODEL1941 MODEL1931	OTHERS	TYPE RSB-0062
CHECKED Apr 23 '01 Y. Ki			名称 空中線部（総合） 回路図
APPROVED Apr 24 '01 S. Yoshi			
SCALE / MASS kg	APPLICABLE TO; (MODEL)	BLOCK NO.	NAME ANTENNA UNIT (GENERAL) SCHEMATIC DIAGRAM
DWG NO. C3380-K01- M	03-121-6007- 9		

FURUNO ELECTRIC CO., LTD.

FURUNO

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Pub NO. DOC-297

Declaration of Conformity CE 0560

We FURUNO ELECTRIC CO., LTD.

(Manufacturer)

9-52 Ashihara-Cho, Nishinomiya City, 662-8580, Hyogo, Japan

(Address)

declare under our sole responsibility that the product

Marine radar Model 1832 for recreational crafts and small fishing boats
(Serial No. 3356-0011)

(Model name, serial number)

is in conformity with the essential requirements as described in the Directive 1999/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (R&TTE Directive) and satisfies all the technical regulations applicable to the product within this Directive

EN 60945: 1997-01 (IEC 60945 Third edition: 1996-11)
KSR 142, Annex 1

(title and/or number and date of issue of the standard(s) or other normative document(s))

For assessment, see

- Statement of Opinion N° 00214141/AA/00 of 19 December 2000 issued by KTL Certification, The Netherlands
- Test report 96328900 of 8 April 1997 and 96328901 of 8 April 1997 prepared by Telefication, The Netherlands

On behalf of Furuno Electric Co., Ltd.

Hiroaki Komatsu
Manager,
International Rules and Regulations

(name and signature or equivalent marking of authorized person)

Nishinomiya City, Japan
January 12, 2001

(Place and date of issue)